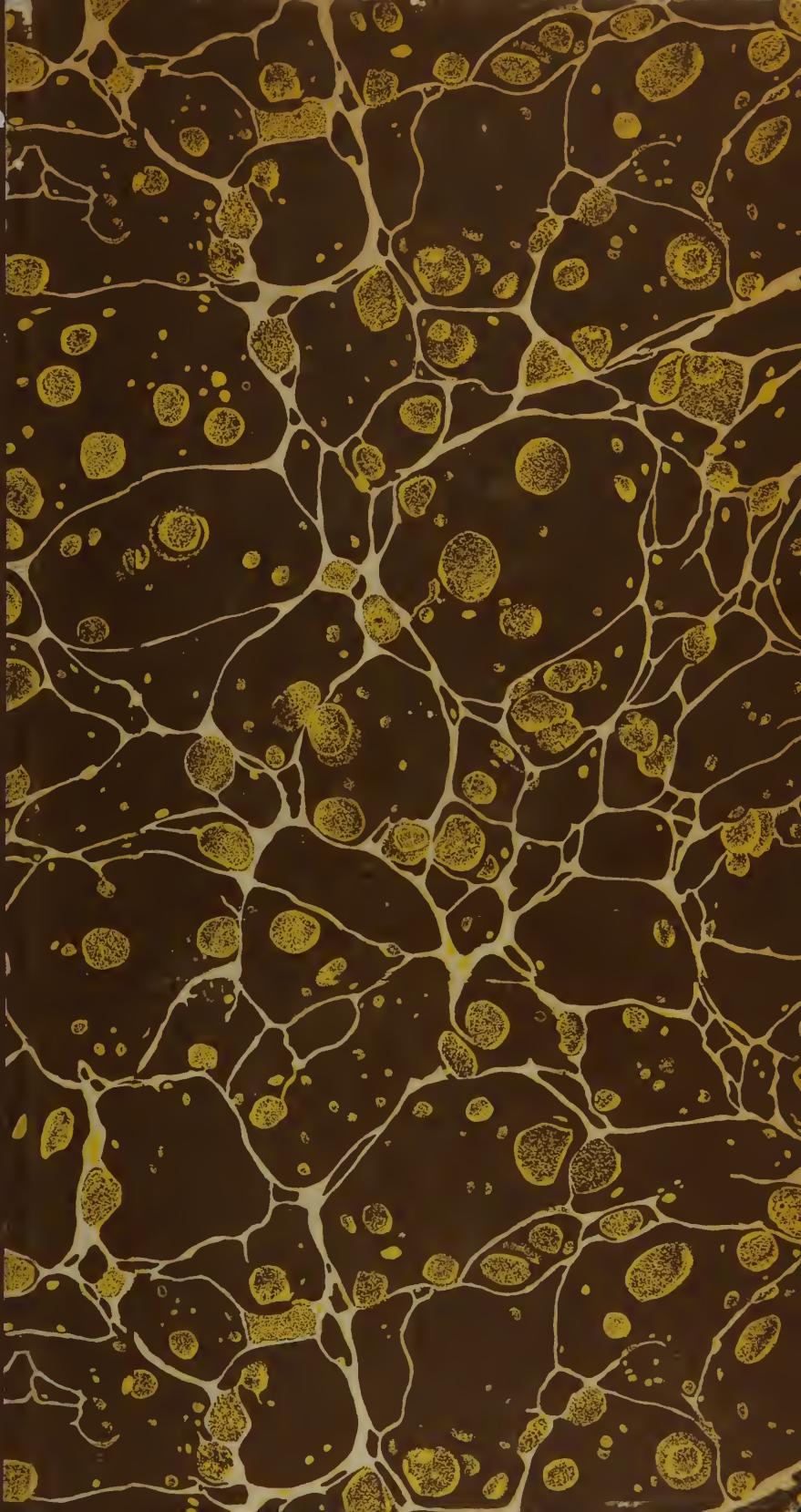


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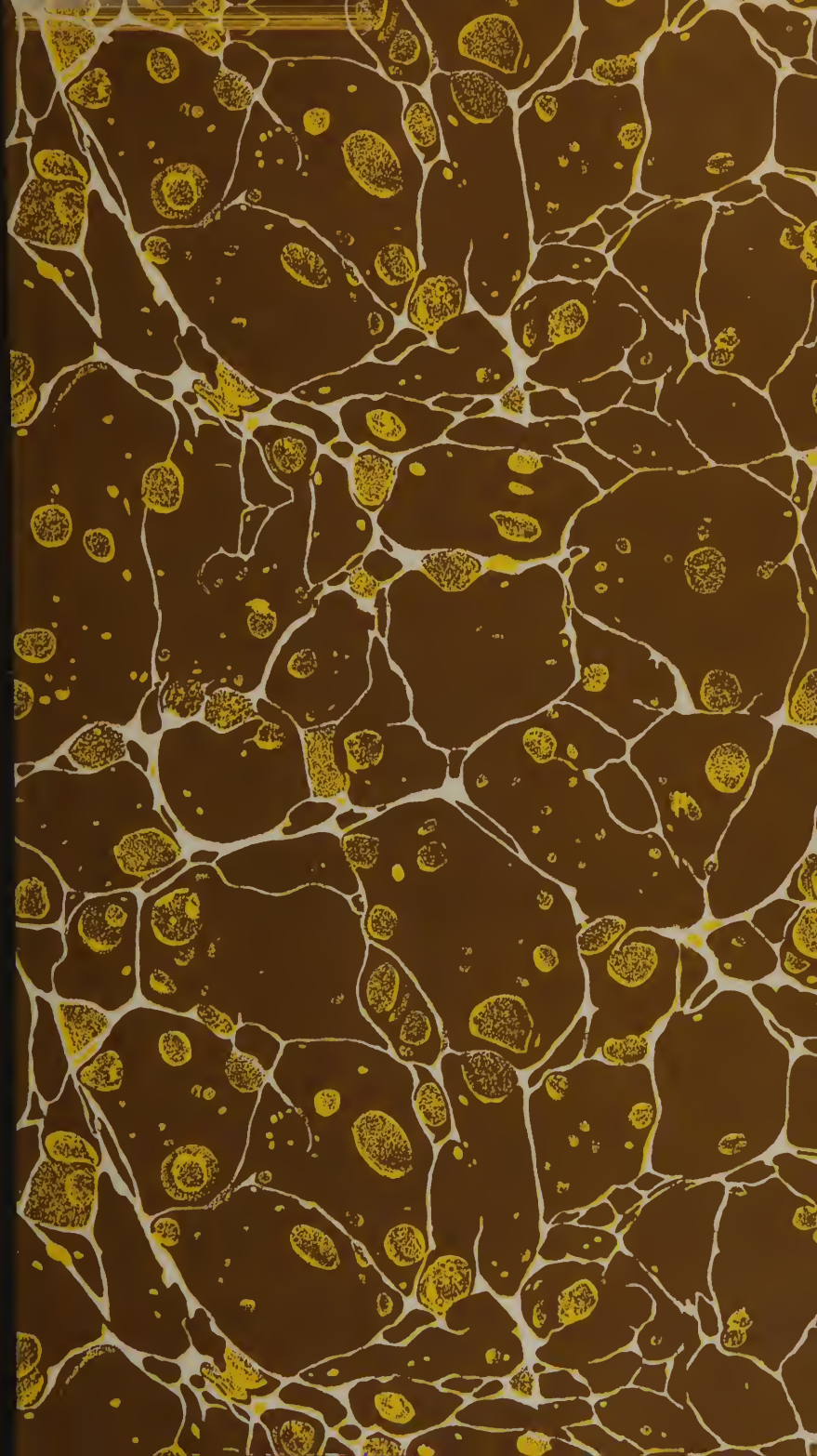
ANNEX

Section .....

Number 18685 .....

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(Revised June 13, 1936)







NOTES

ON

CARPENTER'S HUMAN PHYSIOLOGY,

CONTAINING

SOME ORIGINAL VIEWS OF THE ECONOMY OF NATURE—THE RESULT  
OF REASONING FOUNDED ON OBSERVATION,

BY

LOUIS MACKALL, M. D.

“DE PARTIBUS VITÆ UNUSQUISQUE DELIBERAT, DE SUMMA NEMO.”—SENECA.

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## ADVERTISEMENT.

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The circumstances that have induced me to state my peculiar physiological views in the present form are: 1st, that by adopting this method much time and study are saved that would be required to arrange a systematic treatise. My health at this time not admitting of continued close study, and my time being much occupied by other necessary pursuits, give weight to this consideration. 2nd. This mode furnishes a facility to the reader in comparing my views with those that have heretofore been adopted, and that are now generally adopted by Physiologists. In making this comparison, I ask of the reader that he will bring to the task a mind divested of all prejudice, with a sound, discerning, and unbiassed judgment; that he will first read the paragraph in the text to which each note refers, and where he finds anything in the note opposed to his present opinions, that he will examine well for himself the phenomena or facts connected with the proposition to which he objects, and consider attentively the proposition itself, its applicability, and the facility with which it furnishes an easy explanation of such phenomena or facts; and, finally, that he will, before making up his mind or forming a decision, make a fair and candid appeal to the rule of right which is implanted in his mind as it is in the mind of every man. 3d. By this means I have thought that I might be best enabled to perform a duty I consider incumbent on me—that of making an attempt, however feeble, to counteract the evil consequences that I believe likely to result from the publication of the book on which I have commented.

The tendency of the doctrine inculcated in this book\* is clearly, I think, to promote immorality by fostering a spirit of irreligion—of for-

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\*Let me not be understood as wishing to cast any imputation in any remarks contained in the following Notes on the intentions of the learned Author, nor even as imputing to him any blame. My remarks are intended to apply to the doctrine set forth in his work, which I believe he has adopted without reflecting on its tendency.

I have the charity to believe that Dr. Carpenter would be among the last to admit that this doctrine has the tendency, or is calculated to produce the results which I so earnestly deprecate.

getfulness of God—of Atheism. Introduced, as it is, as a text book in almost all Medical colleges where the English language is used, it is well calculated to spread widely its baneful influences.

In undertaking this self-imposed task, I know that I am acting in opposition to the opinion of Lord Bacon, that the subjects of divine and human learning should be kept separate and distinct; but I believe it to be a truth, that Natural Religion is so intimately connected, so thoroughly interwoven with Physiology, that it would be impossible to tear away the one without seriously impairing, if not entirely destroying, the other. Natural Religion is the true and proper basis of Physiological Science, and a correct Physiology would furnish the clearest and most indubitable proofs of the truths of Natural Religion. Mankind are as capable of reasoning on the subject of Natural Religion, and of arriving at just and firm conclusions, as they are of doing so on the subject of the Mathematics; and, what is of the greatest importance, their happiness is vastly more dependent on the correctness of their conclusions on the former subject than on the latter.

In performing the duty alluded to, I am prompted by no other motive than a wish to promote the happiness of my fellow creatures; or, rather, by a feeling of unwillingness to see the happiness provided for his creatures by a beneficent Creator, wrested from them by Sophistry.

It will be observed in the following pages that conclusions are often stated without reference to the facts or phenomena on which they are founded. This has been done merely to avoid being prolix and tedious; the reader may rest assured, however, that I have advanced no proposition but such as I believe to be true, after having gone through the regular process of reasoning from established facts, with a sincere desire of arriving at the truth.

GEORGETOWN, D. C., *May*, 1852.



# NOTES

ON

## CARPENTER'S HUMAN PHYSIOLOGY.

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### INTRODUCTION.

General propositions, general truths, or propositions relating to a number of instances, constitute knowledge. These general truths are attained by the exercise of a function or act of the mind called Reason.\* There are two ways in which the reason may be exercised; in the one the result of the process becomes palpable, so that the propositions arrived at may be expressed in words, either in speech or in writing. Propositions or general truths so expressed constitute Science. But the process alluded to may pass through the mind in such manner that the propositions, which are the results, can not be apprehended so as to be reduced to words. Knowledge so obtained may be called Experience. "The object of the science of Physiology is" to record or to express the "general laws or principles" relating to this particular subject.

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Sec. 2. The meaning here attached to the terms "Laws of Nature," is forced, and altogether inadequate and unworthy of acceptance. This world is plainly the work of an Intelligent Being, whom we call the Author of Nature, and all the various changes constantly occurring around us, take place in accordance with certain fixed general laws or principles; which laws should properly be understood when the terms "Laws of Nature" are used. The Laws of Nature are appointed by the God of Nature, and are not, as is foolishly supposed, the work of man; the object of the Physiologist should be to trace out these laws as they are appointed and exist in nature, and not to "classify and compare" phenomena with the view to make laws for himself. There is no error deserving of greater reprobation than this attempt (originating I believe in the German schools) to place man in the ridiculous position of making laws for himself, whereby he may be enabled to investigate

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\*See an Account of the Reasoning process.

and unravel the secrets of the Most High. Such efforts always have been, and ever will be, visited with the curse of barrenness. "It was not," says Bacon, "the pure knowledge of Nature and of universality, &c.; that gave occasion to the fall; but it was the proud knowledge of good and evil, *with an intent in man to give law unto himself*, and to depend no more upon God's commandments, which was the form of the temptation."

Sec. 3. This paragraph appears to be sheer nonsense, or, if it has any meaning, it is that the Deity occupies a very subordinate position in the universe; that, simply, of being a direct and constantly operating cause of the phenomena therein, and that the Laws of Nature are framed by Man from the slight glimpses he possesses of the plan according to which the Creator sees fit to operate. In any great plan or scheme projected by man, the inventor or projector gives commands for the carrying out of such plan or scheme, and the operatives, or those under his command, do the work, or in the words of this writer, cause the phenomena. A General in carrying on a campaign gives the orders, which are executed by his subordinates; a Farmer does the same in conducting his crops, &c.; but in the plan of the creation God, according to this writer, is nothing more than the operative directly and constantly at work in producing phenomena which must be in accordance with laws "framed by Man"!!!

Sec. 4. True laws and most general principles are not convertible terms, as the author intimates. There may be true laws as well as most general principles, that is, the laws belonging to any science.

The example given to sustain a silly position contains a false assumption, namely, that in the Vegetable kingdom there is nothing analogous to the nervous system. The Pith and Medullary processes are unquestionably the analogue of the Brain and Nerves of animals, and consequently the opinion that the Nervous influence is essential to the performance of the functions of Nutrition, Secretion, &c., which is an undoubted truth, can not be invalidated by the instances adduced from the phenomena observed in vegetables. The new theory of cells appears to me entirely the work of the imagination, unsupported by any facts, and contrary to the whole analogy of Nature.

1. The distinction drawn between animals and plants is very unsatisfactory. The instances given of the Sensitive Plant and of Venus's Fly Trap, &c., of movements not involving sensibility, are the most unfortunate, for these movements certainly cannot be referred to any

other cause. The true distinction between these two kingdoms of Nature appears to be the difference in the development of the Faculties and Instincts, and consequently the different part allotted to each in the scheme of Creation.

It may be shown, (and it is the province of the Physiologist, as well as of the Moralist, to do this,) that in the scheme or plan of Creation, a part, and an important part, is allotted to man to perform, that we are instructed in, as to the performance required, by commands from its author, and, what is a consideration of the utmost importance, it is so ordered that our happiness or unhappiness, both here and hereafter, is made to depend on our obedience to, or disobedience of these commands. This is the great truth inculcated in the Bible, and a truth at which Reason, when properly exercised, must inevitably arrive. But the German theory, to which we have alluded, would induce us to believe that the Author of Nature is solely and constantly employed in the mean occupation of making cells and in arranging them in certain orders, and that this arrangement alone gives rise to all the various phenomena we observe in Nature; that the Mind of Man and all his Faculties are nothing more than the result of a certain arrangement of cells, and that we are left to work out our own happiness or suffer misery, as best we may, without a hint as to how we are to attain the one or avoid the other. The doctrine is unworthy of serious consideration; it was hatched in some dark cloister in Germany, and is the disgusting product of a perverted imagination.

Yet strange to relate, this proposition, so revolting as it seems to be to the judgment of any one of sound mind, seems to have been embraced without consideration by those who are called "men of science." We find its baneful influence exerting itself in every new scientific work in Europe, and even in our own country. It has accidentally been attached to science, and as mankind are becoming more alive to the importance of science to their well being, and it is thus becoming popular with the masses, this most gross and palpable error is taken along and is exerting its baneful influence in every civilized community. The spirit of Infidelity, I might say of Atheism, (for if God occupies the position assigned to him in this theory, our happiness or unhappiness is not dependent on him, and we could get along without paying any regard to him,) which is now so rife, especially among those called scientific, may fairly be laid to the account of this error. In Geology, in the Natural History of Plants and Animals, in short, in

every department of Physical Science, this doctrine is not only referred to, but is insisted on as a part of these sciences.

The advancement of these sciences may have caused the detection of some errors of detail in the Mosaic account of the Creation; and from some peculiarity of the human mind, men seem disposed to give up the whole as fabulous, and consequently are ready to take up any other account however absurd. They do not consider that the great object of the revelation to Moses was to impress upon the minds of the Israelites, and through them upon the minds of all men, the vast and most important truth, "that obedience to the commands or will of their Maker was essential to, or the cause of, all their happiness; and, on the contrary, that disregard to his will, or disobedience of his commands, was the cause of all their unhappiness or misery."

In imparting the revelation of this truth to the Jews, it was not improbable that Moses should have glided inadvertently into some errors in inculcating it in detail, or in bringing it down to the comprehension of his people; but such errors, it must be admitted, were entirely irrelevant to the matter in hand, and could have no bearing at any future time. The truths of the Physical sciences are of great importance to mankind, for, by the use of them, we are enabled to adapt means for the attainment of ends essential to our well-being or happiness; indeed we have, as Bacon expresses it, "a charter from God," or a command from him, to exercise our reason in finding out these truths, and it is our greatest happiness to be engaged in this exercise; but to these truths we see attached an error, which is not only irrelevant, but which is calculated to sap the foundation of all truth. The lights, both of revelation and of reason, gradually acquired through so many ages, may be extinguished, if mankind allow this poison to spread itself, as they seem disposed to do.

To counteract the result here deprecated, it may not be deemed useless to state our views of the Creation, especially in relation to some details not noticed in Revelation; for we confidently embrace the general truths therein set forth. Instead of admitting the absurdity, that this earth was formed with a view to the creation of man, or, in other words, was created for him, we subscribe to the truth of the exclamation of the four-and-twenty Elders mentioned in Revelation—"O Lord, thou hast created all things, and for thy pleasure they are and were created." We are allowed to look into much that is done in the scheme of Creation, but the human intellect has not capacity to com

prehend "the whole work which God worketh from the beginning to the end." Some parts of this scheme, in which means are made use of for the attainment of ends, are opened, or may be opened, to our gaze, and also some of the laws, by which we see that these ends are made to follow the use of such means; but the great end which the Author of Nature had in view in forming this scheme, and the summary law of Nature by which this end is to be accomplished, is entirely beyond the comprehension of our feeble intellects.

Some of the parts of this scheme that it is given us to behold, are—

1st. That a subtile imponderable fluid has been formed, which may be called life, which is the basis of all matter, or by the different combinations of which all the various forms of matter are formed or effected; but the various changes in these forms are appointed to take place in accordance with certain fixed laws, which have been established by him who is the author of this scheme.

2d. That immaterial Beings have been formed, endowed by the Creator with certain faculties, as observation by means of the senses—Imagination, Judgment, Memory, the Affections, &c.—and are gifted with the power of exercising the functions of Reason, by which general propositions are arrived at; of Invention, by which such propositions are made use of in adapting means for the attainment of ends, &c. The Beings now referred to are called living or organized Beings, including plants and animals. But there is another endowment of these Beings, and it is to this point that I wish to call especial attention, as it has hitherto received notice very disproportionate to its intrinsic importance. The endowment to which I refer is the Instincts. These are nothing less than the commands or orders of the Author of Nature, stamped or interwoven, as it were, into the very existence of these Beings. All the actions or every act of living beings is prompted by their Instincts, or the orders referred to; and if these orders are obeyed in the manner, or to the extent to which the Author of Nature intends that they shall be obeyed, in order to carry out his designs, then the happiness of the creature thus obeying his commands is promoted; but if these Instincts are not obeyed at all, or if not obeyed in the manner he has intended, then the unhappiness or misery of the creature thus disobeying his orders or commands is the inevitable result.

Among these Instincts are—1st. That which prompts them to construct their material bodies; for animals and plants construct their own bodies, under the guidance of Instinct, as certainly, and in the same way, as



the honey bee forms its comb, or as the humming bird its nest—the identity of these Beings existing in their immaterial part, called the Mind or Soul. 2d. That which prompts them, when their bodies are sufficiently developed, after birth, for instance—to interchange life, that is, the basis of matter, with all surrounding material bodies, and to cause such interchange of life. This appears to be the great instinct or command of him who is the Governor of all to all of his creatures. Prompted by this Instinct, we observe with the senses, the objects or forms of matter presented to them; and in doing so we give to them life from our bodies, and receive from them life in return. This Instinct is the bond of Society in every form—of Governments, of Families, of Associations of every kind. It prompts us to seek the society of our fellow beings, as in cities and other communities; and in it originates all transactions, in which one commodity or form of matter is exchanged for another, as in merchandise, &c., and it establishes the several relations of life. He that enters into any of these relations expects to give as well as to receive something, and that something must be some form of the subtile fluid, life. But the most important relation it establishes, in which mankind are concerned, is between us and our Maker. Receiving constantly such innumerable blessings from his hands, it becomes us as constantly to give in return to him our regards; which may be done in words, which are but forms of matter, and in our affections, which are evidenced in determinations of our life, that is, of the nervous fluid, which is our peculiar life. From this brief sketch of the Instinct we have been considering, it will be seen that the amount of happiness derived by mankind from a proper obedience to it is incalculable, and the misery resulting from a disregard to it is of a like extent. 3d. That which prompts to the exercise of all the faculties and functions of our nature—the exercise of Observation, Imagination, Judgment, Memory; of the functions of Reason in finding out general laws; and of Invention, in making use of means for the attainment of ends; of digestion or nutrition; of locomotion, or the exercise of the muscles; of procreation, &c., &c. But little reflection will be necessary to convince us of the pleasure derived from a due exercise of these Faculties and Functions, or of the pain and misery which follow from the want of exercise, or from an excessive or imprudent exercise of them.

From what has been said may be inferred, that all living organized Beings have similar Instincts, for they are endowed with similar Faculties and perform similar Functions. Plants, for instance, are sensible,

in their way, to objects around them; *e. g.* to the materials in the soil in which they grow; they are capable of performing the function called Invention, by which means are adapted to the attainment of ends; and this again presupposes the existence of Reason, for without Reason there could not be Invention. It may further be inferred, that they have the same sources of pleasure and of pain, or of happiness and unhappiness. The distinctions among such Beings must be drawn from the difference in the development of the Faculties and Functions; and an important inference from this view of Creation is, that the classification of the objects of Natural History, or of living Beings, should be founded on their Instincts.

Secs. 2, 3, and 4. The distinction commonly drawn between animals and plants, namely, that the one has a stomach while the other has none, and that, in the first stage of development, the animal forms a membrane in the shape of a sack or stomach, including the materials of its nourishment, while the plant, at the same stage of development, forms a membrane expanded like a leaf, from which it absorbs nourishment, may be referred to their different instincts which prompt them to do this—the object of both being the formation of a subtile fluid peculiar to themselves, called, in animals, the nervous fluid, and by us called life; by means of which only are they brought into relation with the material world, and by means of which only can they produce the changes in the forms of Matter necessary for the structure or development of their bodies, or for the other purposes of their nature. In deriving this fluid from other bodies or forms of matter, a portion of their own peculiar life is given off to these bodies, as in the different stages of nutrition. In the lungs, too, life is derived from the Atmosphere, and the carbonic acid is nothing more than a form of matter, caused by the union of the life of the animal in various forms with the air. We have here instances of the operation of the great Instinct of which we have spoken, which urges us to interchange life, and to effect changes in the forms of life around; *for the Creator effects all the changes in Nature, not directly, but by means of his creatures, whom he instructs or commands to effect these changes.* This law may be observed in its operation in the Corallines that form Reefs or Islands out of the water that surrounds them, as well as in Beings that prey on other Beings.

Here, I wish it to be distinctly noticed, is where I differ in my views from those of the German school, namely, that whereas they consider

the Author of Nature, or "the cause," as directly constructing forms of Matter, from the arrangement of the particles of which, minds or the immaterial parts of animals, result or follow as a matter of course; I, on the contrary, believe that the immaterial parts of all living beings are formed by the Creator,\* and are stamped with, or have interwoven into them, his orders, in accordance with which they are made to effect all the changes that are wrought in the material world. Let no one object to this view of ours, that it is opposed to religion, and especially to the Christian religion, for it entirely coincides with both. It clearly shows, from reason, the vast importance of obeying his commands who is the Supreme Governor of all; for all the happiness of his creatures is shown to depend on this obedience, and this is the sum total of natural religion; and it renders it highly probable that, if his laws were entirely disregarded, God would make use of some extraordinary means of impressing upon mankind the consequences of such disobedience, as Christians contend that he has done by the mission of his only Son, to effect that object. For this is the truth at all times insisted upon by our Saviour, "that obedience to the Will of God is essential to the happiness of mankind both here and in a future state."

There is this further difference between the view of the Creation which I entertain, and that of the German school, namely, that whereas the German philosophers exalt man to a pinnacle whereon he would appear ridiculous to any well ordered mind, that is, as framing the laws of nature,† as being the principal object for which the earth was created,‡ and as being the *ne plus ultra*, or that beyond which nothing superior could be created; § I have attempted to reduce man to his proper position, by showing that he has faculties in common with all other creatures, though more highly developed, originating from the same source, and intended to subserve the same purpose—the carrying out the designs of the creator.

Sec. 5. The most important end intended by the peculiar structure of the bodies of Vertebrata, seems overlooked by Naturalists. I refer to the fact, that their principal nervous centres being shielded from external pressure by means of the bony case of the cranium and vertebra, the animals of this group have a greater power of contracting and dilating the brain and spinal cord, or the nervous tubes of which these consist;

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\*The question, whether each living Being gives occasion for a special act of creation, or whether all Beings proceed from such of their species as were first created, I leave undecided.

† Int. § 3. ‡ Agassiz & Gould's Principles of Zoology, § 501. § Agassiz's Lectures.

and thus possess a more perfect control of the nervous fluid, by the agency of which all motion and nutrition is effected, as well as all impressions, operations, and changes in Nature.

The structure of the bodies of all animals is effected in the same manner, that is, by a peculiar modification of their nervous fluid, or peculiar life. The blood, for instance, having undergone frequent changes in its constituent parts, by being subjected to the influence of various nerves in its course to the bones, or other hard parts of an animal, suffers another change when subjected to the influence of the nerves, whose office is the formation of these bones or hard parts; and thus it is that these parts are formed. It is a very loose expression, that "the surface has the power of producing shelly matter," in which Naturalists are too prone to indulge. Living Beings form all parts of their bodies, under the guidance of their instincts, by means of a distribution of their nervous fluid or life. The mineral matter of bones, &c., is not deposited in them by the blood vessels, but is simply a form of life effected or brought about by the combination of the fluid of the nerves of the part, with the blood or other fluids brought to it.

Sec. 6. Many species of animals, as well as of plants, have the power of propagating new Beings within themselves, that is, they do not require two individuals of different sexes to effect this purpose. These new Beings have their capabilities repressed while in connexion with the parent, but when the part of the body wherein they may be situated is detached, then they take upon themselves the regulation of the economy of that part, as the nutrition, &c. This hypothesis, I think, explains the growth of Polypes, and of buds when removed from the parent stocks. Their power of determining the nervous fluid for the purposes of growth, &c., is overruled, while in connexion with the parent, by the superior power of the latter; but when this power or influence ceases, as by separation, they exert an influence, or perform their part independent of the parent.

Sec. 7. The instincts of living Beings are not generally obeyed, unless under circumstances wherein these instincts may probably be followed by the gratification attached to them. We use no means for the attainment of food, unless we see that these means will probably lead to its attainment. We use no exertion for the gratification of our venereal appetite, without some prospect of having that appetite gratified. The same may be said of all other instincts. The movements or actions of the lower order of Radiata, and of some flowers, may be referred to this general law. They exhibit motion or action under the in-



fluence of light, because the impressions made, call forth the exercise of their instincts, and they have their instincts gratified in doing so.

Sec. 8. In this paragraph, reference is incidentally made to an error which is common to Naturalists, which it may be as well to correct. In the star-fish, the organs of locomotion being connected with vesicles containing a fluid, it is said the contraction of these vesicles causes the protrusion of the feet or organs of locomotion. This is an error. The Author of Nature has instructed animals to form fibres, and especially muscular fibres, which are elongated by means of determining the nervous fluid to them. The organs requiring the greatest supply of this fluid have the greatest supply also of blood, or some analogous fluid. This is especially to be remarked in what are called, erroneously, "erectile tissues," in the genital organs, &c. The organs of locomotion in the star-fish are fibrous, and are elongated like all other organs of the same kind, that is, simply by the determination to them of the nervous fluid, and the fluid in the vesicles performs the same office as the preternatural supply of blood does in erection of the genital organs, or in the action of any other of the muscles, which are observed to have a greater supply of blood the more they are exercised.

Sec. 9. The reproduction of parts, or even of whole members, possessed by some Beings, is owing to the faculty they have of reconstructing the nerves, by means of which these parts or members are produced or formed. The explanation of gemmiferous reproduction may be found in the note to section 6.

Sec. 10. The Tentacula of Polypes, &c., are tubular, and their action the same as all other tubes, that is, by dilating, or being dilated by the elongation of the fibres about the walls, they produce a partial vacuum, and thus cause the flow of fluids to them as the sea water to the tentacula, the blood to the blood-vessels, &c.

Sec. 11: It is an important truth, that the Author of Nature has appointed that all changes in the forms of matter should be effected by secondary agencies, that is, by means of his creatures. This appears to be a principal part assigned to Mollusca in the economy of Nature; the conversion of the different materials found in water, and even the water itself, into other forms of matter—into shells and other solid matter—which process is carried to such an extent in some instances as to form reefs, and indeed, islands, of considerable size.

Sec. 13. The fibres of Mollusca should be considered distinctly from the covering, or skin, or mantle; for by these fibres distinct members



or organs are, in many instances, moved, as the head and horns, as they are called, in snails.

Sec. 15. The office performed by Cilia is not as is commonly supposed, to cause the flow of fluids permeating the tubes in which they are generally placed, (for the dilating and contraction of these tubes, by means of their appropriate fibres, is sufficient to produce this effect;) but the extremities of Cilia are points at which important changes occur in the fluid passing, whereby its life is converted into the life of the animal. It is a nervous process. The life or nervous fluid of the being is given off to the surrounding fluid, and its life received in exchange, by means of the Cilia.

Sec. 17. The actions of all living beings are "directed solely by instinctive propensities," or by their instincts, or the commands impressed upon them by their Creator. These commands may be obeyed or not. All creatures are left free to obey or disobey them. A rule is given to all creatures, which must direct them as to the propriety of obeying or disobeying their instincts. If the judgment is properly exercised, (and the exercise of the judgment is as much an instinct as any thing else,) then the instincts are obeyed in the manner intended by the Author of Nature; and then the happiness of the creature is promoted by thus obeying its instincts, and at the same time the designs of the Creator, in the economy of Nature are carried out, or executed. To direct the judgment, a rule, which may be called the Rule of Right, is implanted in the judgment of every living Being, and if this rule be preserved in its primitive purity, it inevitably guides our actions to the attainment of happiness. The great end or object that should constantly be kept in view in the education of youths, is the preservation of this rule in its primitive purity. Character is the word, that expresses the success that attends this effort. The function of the organs of nutrition, as well as those of respiration, and of the senses, is intended to furnish a supply of the nervous fluid for the purposes of the economy. The Brain and nervous centres are not glands, as has been supposed, for the secretion of that fluid, but bear the same relation to the nervous fluid that the heart does to the blood, that is, they are a principal means of causing its circulation.

The "protective envelope" referred to in the next paragraph, seems to me not so much intended as a protection from injuries, as a means of giving a facility in the motions of those centres, as of dilation and constriction.

Sec. 23. The views of the author are here very obscure, if not unintelligible. What is meant by "instinctive faculties" I do not understand, nor by the expression "of undiscerning and uncontrollable instinct." Instinct, as I understand it, is a command from the Creator, but there are no faculties that I am aware of, destined especially for the performance or execution of these commands or instincts; and the term undiscerning, when applied to instinct, seems entirely inappropriate. By "intelligent will," under the dominion of which, the author says all the operations of the Vertebrata are placed, he probably means simply the mental faculty called judgment.

Reason is a function performed by means of several different mental faculties, as observation, imagination, and judgment. Invention, or that function of the mind by which we are enabled to adapt means for the attainment of ends, is entirely distinct from Reason, although it cannot be exercised until general truths, or general propositions, have been established by the exercise of Reason. Yet the author confounds these two functions together, regarding the employment of means for the attainment of ends, as "the simplest form of the reasoning faculty;" and what is still more absurd, he arrives at the conclusion that "the amount of this (the reasoning faculty,) bears so close a relation with the development of the cerebrum, that it is scarcely possible to regard the two as unconnected. The heart and the muscular apparatus of an ox are suited to carry on the circulation, and to perform the actions or motions required of the ox in the economy of Nature; but would it not be ridiculous to affirm, that it is impossible to regard the immaterial part of the ox as unconnected with his heart or muscles? Or because the heart and muscles are made use of for certain purposes, and are largely developed in the ox, that therefore the immaterial part of the ox must reside in these organs, or be the result of their actions? Yet such are the absurd conclusions of the German school. The Mind or Soul, say they, is nothing more than the result of the actions of the body. Reason is but the result of the action of the brain. How ridiculously absurd! Would it not be as wise to say that a man was but the result of the house he had built, or had lived in; or that a bird was nothing more than the formation of the nest it had constructed, or in which it had been reared?

Sec. 24. If we exercise our Reason at all, we inevitably come to the conclusion that what are called the organic functions, that is Nutrition, the Circulation, &c., "ARE *dependent* on the nervous system for their performance"—are performed through the instrumentality of the nerves.

Sec. 25. The Vertebrata, having a more important part to perform in the plan of Creation, have at their command more vitality, or more of their peculiar nervous fluid; and the increase in their circulation, respiration, heat, globules of red blood, &c., is nothing more than the result of this increase of nervous fluid. "Intelligence peculiarly manifests itself through the brain," because the brain and nerves are the organs which bring the mind or soul (that part in which the personal identity of living beings consists) into relation with the material world. Living Beings are not sensible of any form of matter, nor can they make any impression on other Beings, or other forms of matter, but through the medium of the brain and nerves.

Sec. 27. The swimming bladder in fishes answers the purpose of a float, as the lungs answer this purpose in other animals that swim. It can be filled at will with a fluid secreted by its walls, possessed of little specific gravity, which serves to buoy the fish up as the inflation of the lungs does other animals. This fluid can be discharged, when no longer needed, through the passage which communicates with the œsophagus.

The explanation attempted to be given, in this paragraph, of the circulation of the Blood, I have heretofore shown to be erroneous. The Auricle is not peculiarly a "recipient cavity," nor the Ventricle peculiarly a propellent cavity, for both cavities are recipient, and both to a certain extent propellent. When in an active state, or in a state of action, both cavities are recipient; and when in a passive state, or when the state of action has passed from them, they are both passively propellent; and the same may be said of the aorta of fishes, and of all the tribes of living beings.

Sec. 28. The account given of the mechanism of the respiration of reptiles is ridiculously absurd. Respiration in these animals is effected as in all other animals with lungs—that is, by the active dilatation of the sacs constituting the lungs; the only peculiarity in reptiles being that the sacs, in some orders at least, as in Chelonia, are dilated without the concurrent action of what are called muscles of respiration. I have never seen the experiment made of suffocating reptiles by holding their mouths open, but doubt the truth of the assertion.

Sec. 33. The object to be attained by the respiration of birds, as of all other living beings, is the reception of life, or the basis of matter from the atmosphere, which is converted into nervous fluid, or the peculiar life of the Being; and, in order to this conversion, a preterna-

tural supply of the nervous fluid is transmitted to the parts or organs receiving it, and thus the blood and muscles in those organs receive an increased supply of this nervous fluid. Thus it is that blood has its appearance changed. This change is effected by the nervous fluid, I mean in a normal or natural state of things as it occurs in the living body, although similar changes may be brought about by the oxygen of the atmosphere. In inflammation, where there is a preternatural determination of the nervous fluid to the seat of the inflammation, the color of the blood is changed.

Sec. 35. The air cells in birds serves the same purpose as the swimming-bladder in fishes—they are mere floats, that may be filled with a volatile gas which the bird secretes, and which is discharged through the lungs.

Sec. 37. The want of a diaphragm in Reptiles, was said (section 28) to be supplied by the mouth or upper jaw, which forced the air into the lungs; the want of a diaphragm in birds, we are told, is supplied by the muscles which the bird exerts to expel the air from the lungs; but what muscles? Neither the muscles of the chest, nor those of the abdomen, could possibly produce this effect. The truth is, that birds, as well as reptiles, and all other animals possessing lungs, respire by dilating and contracting the lungs by means of the fibres constituting their walls. The respiration of insects is effected by the elongation and contraction of the spiral muscle which lines their trachea.

Sec. 39. This paragraph is obscure and unintelligible. What is meant by “instinctive powers?” The instincts, I conceive, are the commands which the Creator has impressed on his creatures. All the actions of all living beings are prompted by these commands or instincts, and the happiness or well-being of all creatures are made the condition of obedience to these commands in the manner intended by their Author. The selecting a place for their nests, collecting materials for the same, building the nests, rearing their young, migration, &c., are acts which birds perform as they do all other acts, that is simply because they are appointed or commanded to perform them. They find that, in performing these acts, their happiness is promoted, which is evinced to observers by the alacrity of their movements, &c. But it is a part of the plan of Creation that birds, like all other creatures, are left free agents, so that they may obey or disobey these commands or instincts. A bird might fail to select a place for its nest, to collect materials, or to perform its due migration, or any of these in-



instincts might be perverted; it might select an improper place, collect improper materials, or perform its migration at a wrong season; it might fail to take food at proper intervals, or to indulge its other appointed appetites. But it will be acknowledged at once, that the consequence of this disobedience, or perversion of the commands or instincts of its Creator, would be a state of unhappiness. So certainly would we be convinced of this, that we would immediately refer this disobedience or perversion to some disease.

There are two important functions of mind, Reason and Invention; by means of the one, general conclusions are arrived at, and by means of the other these general conclusions are made use of for the attainment of ends. The stratagems employed by birds, and their adaptation to varying conditions, are instances of the exercise of Invention, or the adaptation of means to the attainment of ends; which exercise birds are prompted to, or have an instinct or command to perform, as well as all other living beings.

Sec. 42. There can properly be no contrast between the reasoning and instinctive powers, because the exercise of Reason is an instinct, and obedience of this instinct or command, in the manner appointed by the Creator, is the source of the purest happiness of which our nature is capable. Invention, or the adaptation of means or actions to gain certain ends, is another most important instinct, inferior to the former, but furnishing also a vast source of happiness to men, as well as to other animals; but it is a palpable error to confound this function of the mind with Reason, and to consider the two functions or acts of the mind as identical or synonymous.

Sec. 43. "The high development of intelligence in Mammalia" is referrible simply to the will of the Creator, who has given them peculiar instincts, that they may perform the part assigned to them in the scheme of Creation.

Sec. 58. The superiority of Man over Brutes, in resisting their attacks, and in bringing them into subjection to himself, is not attributable solely to his possession of superior reason, but is mainly owing to his superior Invention, or the superior development of the function by which he adapts means to the accomplishment of ends. In the case instanced by writers, of a few men cast upon a desert island, and attacked by a large number of rapacious beasts, the superiority of the men in resisting the attacks of the beasts, and their ability finally to extirpate them, would arise, not as has been supposed "from a union of



their forces," but from their power, arising from the peculiar constitution of their minds, to adapt means for the attainment of the particular ends or objects they might have in view. It is very true, that if these men had studied the art of war, or had reasoned out the general propositions constituting the military science, their efforts would be more efficient; but there is no doubt of their prevailing, under such circumstances, without having thus exercised their reason to any great extent.

Sec. 60. The distinguishing characteristic of Man, and that wherein he excels all other creatures, is his power to exercise his reason, so that the results may become cognizable to the Senses, that is, may be expressed so as to be communicable from one to another. The result of reason, or reasoning thus expressed, I have proposed to call Science. The trait, then, in which Man differs from all other animals, is his ability to attain that form of knowledge called Science. It is by means of this characteristic trait that the general character of the human race is constantly improving; and this improvement is greatly accelerated in civilized communities by means of schools—a principal object of which is to communicate the results of human reason. Improvement is more rapid in races that have the faculty of Invention the most developed.

Sec. 61. The propensity which leads us to acknowledge the existence of a God, like all other propensities that are not depraved or perverted, may clearly be traced to an instinct or command from God directly. We arrive at the same truth, however, indirectly, by means of the instinct that prompts us to exercise our reason. We can furnish no explanation satisfactory to our own minds of the innumerable instances of design observed in the Creation, without acknowledging that these designs are planned by an intelligent Mind. The adaptation of means to the attainment of ends which is so constantly observed in Nature (and that, too, entirely independently of the wills of the creatures, that are made use of as instruments in these designs,) which we have shewn to be the result of a mental function Invention, leads at once to the conclusion that these designs proceed from an intelligent Mind.

Notwithstanding all the discourse in this paragraph about "the propensity of man to acknowledge a Deity," "his desire implanted in his mind to share his spirituality, an acknowledgment that man is possessed of an immortal soul, of which fact he is informed by Revelation," "by which he is connected with beings of a higher order"—and not-

withstanding he is said to be encouraged to aspire to an intimate communion with his Creator, still, under all this disguise and all this cloaking, a careful observer may detect the cloven foot of the materialist. Dr. Carpenter, it is clear from his writings, is a disciple of the German school which places man's personal identity in his material part, in his body. His mind is the result of the action of his bodily organs; thought is an action, a secretion of the Brain; and Reason, and all the other mental Faculties and functions proceed from the same source. The motions or actions of the body, such as the circulation of the Blood, Digestion, &c., are, according to this school, but the result of the peculiar arrangement of the particles of matter of which the body is composed. To one who has perverted his reason so far as to arrive at such conclusions, the next step is an easy one, and that step is to infidelity, to a disbelief in, or a disregard of the existence of a Deity and taking another easy step they deny altogether the existence of a soul. These steps are what ninety-nine out of every hundred of the disciples of this school are observed to take.

Sec. 68. There is no doubt in my mind of the fact that all living beings construct their own bodies under the guidance of instinct.\* Indeed a careful attention to the subject will show to any fair mind the absurdity of supposing that the bodies of such beings have any other origin; and the instances of the change in the form of the members as the change in the hoofs of hogs spoken of in the text, (if such instances do exist,) are either instances of perversion of the natural instinct caused by accidental circumstances, or they may be instances of the exercise of the function of the minds of such beings, which we have called Invention, by which, means are suited to the attainment of ends.

Sec. 77. If the bodies of living Beings are formed by themselves under the guidance of their instincts, and if every species of Being has peculiar instincts, then the true and proper basis of the classification of such Beings is their instincts. Thus, in a classification of birds, the color of their plumage, the shape of their different members, their habits, their migrations, their peculiarities of food, and of taking their food, the choice of a place for their nests, the structure of their nests,

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\*The very frequent repetition of the same ideas to be met with in these pages will, it is hoped, be excused. This has been done purposely, in order to make the reader familiar with propositions that are believed to be new to him. The use of the same instances on various occasions, has been adopted that the subject might be rendered as plain and simple as possible.

&c., &c., which are all mentioned in works on Natural History, as characteristics of species are yet all merely the result of instincts.

Sec. 106. Here we have plainly and clearly stated the fundamental principle of the doctrine of Materialism as taught in the German school of philosophy. Personal identity is placed in the material part of living beings; and what is still more absurd, intelligence is made an attribute of matter; mind, or the immaterial part of living beings, is but the product of the action of cells, or the result of a peculiar conformation or arrangement of particles of matter; and what is still more ridiculous, individual parts of the bodies of living beings are endowed with intelligence; thus "in the simplest forms of living beings we find a single cell; this cell grows, absorbs, and assimilates nutriment, converts a part into the substance of its cell wall, secretes another portion into its cavity, and produces from a third the reproductive germs that are to continue the race" !!! Materialism is the prevalent doctrine of the age, and is being propagated throughout the civilized world. The disciples of the German school are increasing in numbers rapidly, especially from among the so-called votaries of Science. The doctrine opposed to Materialism, and to which I subscribe, and which I believe to be true, has been condemned by a large majority of those calling themselves philosophers, and thrown out of consideration as utterly false. The fundamental principles of the doctrine which I embrace are—1st, that the personal identity of all living beings consists in an immaterial or spiritual existence, called the soul or mind, which is created by the Author of Nature, and which is endowed with certain faculties, as observation, imagination, judgment, memory, &c., by means of which it is enabled to perform certain acts or functions called reason, invention, &c., and upon which are stamped the orders or commands of its Creator, which are what should be understood by the instincts.

2d. That the acts of all living beings are prompted by these commands or instincts.

3d. That the work of Creation was done in accordance with some vast scheme or design which its Author had in view; which scheme, in all its parts, is entirely too vast for human comprehension, although parts of it may come within our grasp.

4th. That we as well as all other living beings are so constituted that if our instincts, or the commands impressed upon our minds, are executed in the manner intended by the Author of Nature, that is, in the manner calculated to carry out the design of Creation, then our

happiness is promoted; and if those instincts are not executed in this manner, that unhappiness or misery is the necessary consequence.

5th. The general instincts are, the exercise of the faculties with which the mind is endowed, and the exercise of the acts or functions of the mind which are appointed to be performed.

The special instincts are—1st, the giving and receiving life, or a subtle fluid, to and from other beings and other surrounding objects. 2d. The instinct which prompts us to seek society. 3d. The instinct which prompts us to take food. 4th. The instinct which prompts to the gratification of venereal desires. The exercise of the affections, as love, fear, hatred, anger, envy, &c., may be referred to the first of the special instincts, that of giving and receiving life. The exercise of the affections in an undue or excessive manner, which constitutes passion, is brought about or affected by an improper excitation of the imagination.

In what manner the instincts are to be executed, or the commands of the Deity obeyed, we are informed in part by Revelation, and in part by observing the consequences of our conduct, or by being told of the consequences by others, or having learned those consequences by the study of the system of morals or Moral Philosophy; but our principal guidance is derived from the Rule of Right,\* of which we have spoken in section 17. 5th. The nervous system, including the brain and other centres, is the means by which living beings are brought into relation with the material world, for all living beings have nerves, or something analogous. They receive no impressions from surrounding objects, but through the medium of the nerves; neither can they produce any impression on such objects, except through the same me-

\*This term is intended to express not only what should properly be understood by the terms Conscience, the Moral Sense, the Principle of Virtue, &c., but also the Rule that applies to minor or more ordinary occurrences. On every occasion of life we should ask the question, what *ought* we to do? and take directions from this rule, which is implanted in our minds for this very purpose. By doing this it will be found that we promote our own happiness at the same time we are obeying the will of him who has made this provision for the happiness of his creatures.

It will be seen that I have not, in this work, adverted to the doctrines and truths of Revelation, except in occasionally pointing out the correspondence of such truths with the conclusions that might be arrived at by reason. I embrace these truths freely and gratefully, though with humility, arising from a consciousness of my inability fully to comprehend the whole of them; but, it seems to me, that an attempt to elucidate these divine truths by any exercise of human reason, would be presumptuous and altogether out of place in a work of this kind.



dium. 6th. The nervous centres are not glands as is commonly supposed, which secrete the nervous fluid, but they are merely organs by means of which the nervous fluid is made to circulate. They perform the same office in the circulation of the nervous fluid that the heart does in the circulation of the blood. 7th.. The brain is not the organ of thought, which is exclusively an operation of the mind, or of the immaterial part of living beings ; but it is a principal organ in giving expression to thought by causing the circulation of the nervous fluid to and from the muscles appointed to give these expressions. When the mind is in operation, it naturally or instinctively determines the nervous fluid to its principal centre, the brain, in readiness for distribution; and hence the brain has been considered the organ of thought. 8th. The nervous fluid or peculiar life of a living being is derived from the subtile fluids which are continually escaping from surrounding objects, which become assimilated in passing through the nerves in the same way as the blood becomes assimilated as it passes along the blood vessels; and from the secretions which are commonly stored up for that purpose. 9th. The action of muscles consists not in the contraction but in the elongation of their fibres. In locomotion, for instance, the impetus given to the body is caused by the elongation of some of the muscles of the extremities, and this elongation is caused by the presence of the nervous fluid, which has been conveyed to them by the nerves. The contraction of other muscles of the extremities at the same instant is attributable to the fact, that the nervous fluid is withdrawn from them to furnish the increased supply to the muscles that are elongated. In grasping an object, the extensor muscles of the hand are in a state of action, while the flexor muscles are in a contrary state. 10th. The active state of the tubes consists in dilatation, which is effected by the active elongation of the fibres about their walls ; and from this view of the subject we may see how it is that muscles become contracted : for, if there is action in the nervous tubes constituting the nervous centres, which action causes their dilatation, it is evident that the nervous fluid would thus be withdrawn from the muscles and cause their contraction ; thus it is that stimulants applied, under certain circumstances, to a part of a living body, by producing action in the corresponding nervous centre, may cause the contraction of the muscles of the part to which they are applied ; or they may produce a constriction of the tubes in the same way, as is sometimes witnessed when stimulating applications are made to the dilated blood vessels of the con-



junctiva, in chronic ophthalmia. In all these instances, the impression made upon the nerves is followed by action in the nervous centres, and not at the point where the stimulant is applied; and all these instances are but exceptions to the general rule, which is thus quaintly expressed by the old authors: "*Ubi irritatio ibi fluxus.*" Where there is irritation, there is a flow of the nervous fluid, and the flow to the part, of other fluids is the consequence of this flow of the nervous fluid, causing the dilatation of the tubes; which is an instinctive act of living beings for the purpose of resisting or of repairing injuries. 11th. The different forms of matter which enter into the composition of living beings are formed by the combination of the nervous fluid, or the peculiar life of such beings, with the fluids circulating in their tubes, which combination takes place invariably in accordance with certain fixed laws which have been established by the Author of Nature; but the providing the circulating fluids, and the determining the nervous fluid to them is the immediate work of living beings themselves, to which work they are prompted, as in all their other acts, by instinct. From this reflection we come to the conclusion, that the Author of Nature not only does not form the compound parts of living beings, on which point the German philosophers insist so strongly, but we may safely conclude, that he forms no part whatever of those bodies, not even an elementary cell. His action in the creation of such bodies is limited to the creation of the spiritual part of living beings; to the issuing of his orders, and stamping them upon the immaterial portion of his creatures. This conclusion, if true, and it seems to me but little reflection is required to convince any sound judgment of its truth, at once overthrows the whole fabric of Materialism. For it shows that the different forms of matter may be formed by minds guided by instinct, and that it is untrue that minds may be formed by the peculiar arrangement of particles of matter.

Sec. 107. Having embraced the tenets of the German school of physiology, which is guilty of the monstrous absurdity of giving intelligence to matter, the author proceeds in this and some following paragraphs to explain the functions called those of organic life, by referring them to the agency of cells; and throughout the whole account of these functions not a single reference is made to the mind or immaterial part of living beings, in which we have stated our belief that the personal identity of such beings exists. Neither is any mention made of Him who has created all things, and by whose directions or orders these

functions are exercised. The cells of the spongioles in plants perform the absorption of the nutritious fluid; the cells of the leaves convert the sap into latex; certain groups of cells separate the secretions from the sap; and he then calls attention to the fact "of the transitory life of these cells as individuals." The author proceeds to show, in sec. 109, that reproduction also is dependent upon the agency of cells, in proof of which he adduces the phenomena observed in Cryptogamia, where each cell is an independent individual, and where each cell has the power of preparing within itself reproductive germs; and not content with these assumptions, he refers to distinct groups of cells, the animal functions of absorption, assimilation, respiration, secretion, and reproduction, and also those of muscular contraction and nervous action, which, he says, they alone perform.

Now, this whole account of the operation of cells appears to my judgment, to be a tissue of folly and nonsense. It is not the result of reasoning, for it is not founded on the observation of any fact; neither could it be approved of by the judgment of any sane mind. The proposition that cells are endowed with intelligence; that they perform all the acts attributed to them above; that they perform these acts independently of each other, and yet all concurring in effecting one common object—the maintenance of the integrity of the entire organism—this proposition, I say, if presented to a well constituted mind, divested of the tinsel of fine language, and unsupported by the authority of such as pass for men of science, would be at once rejected as being absurd, and as being merely the work of a diseased imagination.

In opposition to this view of the economy of Nature, let us recognise an all-wise Intelligence who has conceived a vast design, and, as a part of this design, creates a spiritual being, which he endows with certain faculties, and on which he impresses his orders or instincts. The materials being provided, this being is set to work with the guidance of its Instincts. It first forms a Nervous System, by means of which it is brought into relation with the material world, or by which it is enabled to operate on, and be affected by, material objects. It then proceeds to form, out of the materials presented to it, and by the agency of its nervous system, the organs that may be necessary for its future existence, or to accomplish the ends for which it was designed by the Creator. It forms its bodily organs precisely as a bird forms its nest, or the honey bee its comb; and all this is effected by the agency of the nervous fluid. It determines the nervous fluid to the materials pro-

vided for that purpose, and thus forms the fibres for the walls of the tubes. It determines another form of the nervous fluid to these fibres, and their elongation, and consequently the dilatation of these tubes, and the absorption of nutritious fluids take place; and determines the nervous fluid again to combine with this nutritious fluid at certain stages of its course, and thus the different organs are formed; and, again, the combination of the nervous fluid with the circulating fluids gives origin to the secretions. It performs all the various functions of its economy, because it is instructed to do so by its Creator.

12th. All living beings are made free agents; they are at liberty to obey their instincts or not as they please, or they may pervert them; that is, obey them in a manner not designed by their Creator. Thus, we may take food or not take it; we may take less than is adequate for the purpose for which it is intended, or we may take it in excess. Intemperance, whether in meat or drink, are instances of the latter. But all beings are gifted with the Rule of Right, which is intended to guide them in obeying the Instincts, and are so constituted that they are rewarded for a proper obedience of their instincts, or for their observance of the Rule of Right, by experiencing a sense of happiness—by which term I mean a sensation of what is called well-being, and not, what is frequently mistaken for it, excitement or pleasure; for an undue or improper indulgence of any of the instincts is accompanied by pleasure or excitement. This sensation of happiness, or of well-being, is the inducement held out by Infinite Wisdom to lead his creatures to act in accordance with his designs. On the contrary, all living beings are punished for any disobedience of their instincts, or improper indulgence of them, or for a disregard of the Rule of Right, by a sensation of unhappiness or of misery, which, when exalted in our species, is called remorse; and this sensation is the means instituted by Providence to deter his creatures from a disregard of this rule, or undue indulgence of their instincts; to teach mankind in what manner their instincts should be obeyed, or, in other words, meaning the same thing, what conduct or what actions are in accordance with the will of God, they have not only this Rule of Right implanted in their minds, but this is an important object of the Christian Religion; and hence it is a matter of plain observation that nations, as well as individuals, have become prosperous and happy, in a direct ratio with their cultivation of this institution in its purity.

A part of the above view of the economy of Nature was proposed

to the consideration of Physiologists, ages since, by Stahl, who supposed that all the functions of the body were performed by an intelligent being, that is, the soul; but his opinion was rejected on the ground that, if this were admitted, then brutes must be allowed to have souls also; which supposition was at that time thought sufficient to reduce the proposition of Stahl to an absurdity. Mankind alone, of all God's creatures, were allowed to be possessed of souls or minds, and to allow them to brutes was considered an attempt to drag mankind from the high position appointed them in the plan of Creation. The general sense of mankind, at this time, at least of the intelligent portion, approves of the proposition that brutes are possessed of souls or minds, and considers the admission not at all derogatory of our privileges. The question, whether brutes are to be continued to a future state, in common with mankind, is now properly regarded as no concern of ours, but is properly left to the decision of him who created them.

Sec. 112. Albumen is the result of the action of the nervous fluid, or peculiar life of animals, on the fluids absorbed and brought within the sphere of its action.

Sec. 114. Fibrine is a more animalized substance than Albumen, from the fact that it has been more exposed to the action of the nervous fluid. Albumen, then, when exposed to the action of the nerves, becomes Fibrine.

Sec. 119. Fibrous tissue, as well as the osseous, and all other organized tissues, are produced simply by the action of the nervous fluid upon Fibrine.

Sec. 122. Cells are formed by the being itself, or immaterial part, under the guidance of its instincts, as the bird forms its nest, or the honey bee its comb; so also are formed the tubes or sap vessels. Giving intelligence to cells, and making them reproduce germs, is absurd. Is the crop made by the plough; or is it not rather made by the intelligence of the farmer and his agents?

Sec. 150. There is no occasion for the far-fetched hypothesis advanced in this and other paragraphs, when all the phenomena are explained by making all the various changes, taking place in the circulating fluids, to depend upon the action of the nervous fluid.

Sec. 158. The phenomena of inflammation are all satisfactorily explained by our hypothesis, as are also all the other facts mentioned by the author. The increased number of colorless corpuscles at an inflamed point, in the whole system, where there is an inflammatory



diathesis, and in young animals possessed of much vitality, is owing to the action of the nervous fluid, which is instinctively determined to the blood vessels, and to their contents, under precisely such circumstances. An increased flow of the colorless corpuscles, or of any one part of the circulating mass, to any one point, is entirely incomprehensible, without supposing such corpuscles or parts to be endowed with intelligence, which, to my mind, is unspeakably ridiculous and absurd. The elaboration of Fibrine may be a consequence of the formation of colorless corpuscles, or may be the express object of their formation; that is, the formation of these corpuscles may express one stage of the union of the nervous fluid with the nutritious fluid, when a further object of this union is the formation of Fibrine.

Sec. 161. The development of epidermic cells is not solely attributable to a determination of blood to the skin or cutis; but the determination of the blood, as well as the formation of the cells, are caused by the action of the nervous fluid, which is instinctively determined to any part of the body where there is friction or irritation. The thickening of the epidermis itself is a source of irritation, and hence it is that corns, which are nothing more than layers of the epidermis, sometimes continue to grow even when friction is removed or prevented.

Sec. 172. Cilia perform the same office on the internal mucous membrane, and upon serous membranes, as the hair does on the skin; that is, they are points by means of which the life of the animal is given off, and through which the life of surrounding substances, and of the secretions, are conveyed into the economy. The growth of hair may continue in the dead body in the same way as the motion of cilia continues; for their functions continue after death. The process of giving off and receiving life is carried on until the body is decomposed; but this process is subject to other laws after death, and is effected by other means than those of the living body.

Sec. 192. The formation of bone, and of all other animal solids, is clearly owing to the combination of the fluid of the nerves appropriated to that purpose, with the materials that have been prepared in the circulation for this change of form.

Sec. 240. There is not a single fact stated in the whole account of the structure and action of muscles, contained in this and some preceding paragraphs, that militates against, or is at all opposed to, the proposition, that muscular action is dependent upon the presence of a subtile fluid, which we denominate the peculiar life of the animal; or



to the still more important proposition, that the presence of this fluid causes the elongation, and not the contraction, of the fibres or fibrillæ of muscles; and that the absence or withdrawal of this fluid causes the contraction, and not the relaxation, of the same fibres or fibrillæ. The myolemma is calculated to confine the action of the fluid to the fibre which it encloses. The effect of the fluid may be to separate the disks or striæ from each other, as seen in fig. 100, or to change the form of the cells from the form of a square to that of an oblong, fig. 99.

Sec. 246. We have said, in a note to a preceding paragraph, the materials of the nervous fluid were derived from surrounding bodies, and from the secretions, and that these materials undergo a change, in passing along the nerves, which fits it for the various purposes of the economy; and we advanced the opinion that the brain, and other centres, performed the same function in the circulation of the nervous fluid, that the heart does in the circulation of the blood. The vesicular substance contained in the centres may have an office distinct from the tubular portion, by virtue of which it may effect changes in the constitution of the nervous fluid, analogous to the changes effected in the blood by means of the liver.

Sec. 254. The greatest confusion of thought is evinced in this and some following paragraphs. "The idea of Life, in its simplest and most correct acceptation," is not "vital action which involves change," all of which expression is sheer nonsense; but the idea to be attached to the term Life should be, that it is a subtile fluid which is the basis of matter. The notion of change that is commonly attached to the term, or associated with it, is derived from the circumstance, that one of the most important laws of Nature relating to inanimate bodies is, that there must be between these bodies a constant interchange of this subtile fluid, and also the most important instinct or command impressed upon living beings is this same interchange of life between each other, as well as between them and surrounding inanimate bodies. The interchanges of life among inanimate bodies take place in accordance with certain laws of Nature that are called Chemical. The interchanges of life taking place among animated bodies, or living beings, are carried on in accordance with other laws of Nature, called Vital, or laws of Vitality. The subtile fluid, which is the basis of all matter when it enters the economy of a living being, becomes compounded, elaborated, and changed to a form in which it is adapted to effect the various changes required in such beings; but all such changes are effected under the

superintendence of the spiritual and intelligent being in which the personal identity of such beings consist. By superintendence, is meant, that living beings determine their peculiar life to points where such changes take place; and that these changes could not take place without such determination, and without certain alterations or modification of the fluid which are effected by these living beings in the passage of the fluid to such points.

The Oyster and Ascidia referred to in the text are each possessed of an immaterial and spiritual existence or being, totally distinct from their bodies; on which spiritual beings are impressed instincts, and among them that by which they are prompted to effect the changes they do effect in their bodies and in the objects around them. These changes are brought about by the agency of the peculiar life of the animal, which life is under the control of the spiritual being of which we have spoken, and consequently should be regarded as effected in accordance with the laws of Nature called Vital, and as entirely independent of chemical laws, which relate solely to dead or inanimate matter or bodies.

The office performed by Cilia has been explained in a previous note, section 172. "The Oyster closing its shell, and the Ascidia contracting its muscular tunic, when it receives any kind of mechanical irritation, and the former, whilst lying undisturbed in its native haunts, drawing together its valves if a shadow passes between itself and the Sun," may all be referred to the agency of the spiritual being which constitutes its identity, which withdraws its nervous fluid or peculiar life from its muscles to its nervous centres, and thus causes the contraction of the former. Whatever "has been already stated regarding the nature of the actions of the Nervous and Muscular systems, by which the movements of animals are chiefly effected, which would make it appear that these, in common with the Vegetative functions, involve a chemical alteration in the structure performing them," is utterly false and unfounded in fact; and the general proposition, "*that a change in chemical composition is an essential condition of every vital phenomenon*," is altogether gratuitous, and is introduced here, unconnected as it is with the rest of the paragraph, merely as a hook on which to hang the doctrine of Materialism, of which the author is a firm supporter. If there is any use for the terms vital and chemical, it is to distinguish the two classes of phenomena, one of which occurs in living beings, and the other in inanimate matter; and the attempt to make the

one class dependent on the other is calculated to render the terms of no avail whatever by depriving them of any definite meaning.

Sec. 255. In the earliest periods of existence all living beings require impressions to be made upon them by external objects to bring their otherwise dormant powers into play, so far as to enable them to develop their bodies under the guidance of instinct. The ova of animals for the most part derive the necessary impressions from the parent; others derive them from the fluids, that is, the atmosphere or other fluids with which they happen to be placed in contact. The seeds of plants derive the necessary impressions mainly from the source last mentioned. Hence it is that such ova or seeds "may remain unaltered during a period of many centuries; vegetating at last, when placed in favorable circumstances." The admission of the author, that the state above referred to is exactly similar to that of a hibernating animal, or of one during sleep, contradicts his assertion that a seed under the circumstances supposed is not alive; for animals, when torpid, or when asleep, are unquestionably alive.

Sec. 256. Having advanced in section 254 the fallacious proposition that a change in chemical composition is an essential condition of every vital phenomenon, the author here disproves it by asserting that there is a large number of phenomena in the living organism which can not be in the least explained by the operation of physical and chemical forces. He says, in the former paragraph, that the actions of the muscular system involves a chemical alteration in the structure performing them; and here he avers that "the contraction of a muscle" is a vital phenomenon, and "its character and condition appear to be totally distinct from those of Chemical or Physical phenomena!" He proceeds to attempt an explanation of muscular action, and involves the whole subject in the most inextricable confusion by using terms and expressions that have no sensible meaning, as "vital force," "contractile force." "This dormant force is termed a property;" "thus we regard it as the essential peculiarity of living muscular tissue that it possesses the vital property of contractility," all of which is pure nonsense. The simple truth is, that whenever a muscle is in connection with a spiritual being by means of nerves, it may be brought into action by this being determining its nervous fluid to it, and may be contracted by this being withdrawing this fluid from it. It may also be contracted by the loss of its nervous fluid in any way. There is not the slightest necessity for the use of the term contractility in explaining

muscular action, and this supposed property exists no where but in the Imagination. This sentence, "the muscle is said to possess the property of contractility; the property, called into operation by the appropriate stimulus, gives rise to the contractile force, and the force produces, if its operation be unopposed, the act of contraction," is unqualified nonsense.

Sec. 257. I regard the circumstance, that "it is now almost universally admitted by intelligent Physiologists that we gain nothing by the assumption of some general controlling agency, or vital principle, distinct from the organized structure itself," as one of the most deplorable misfortunes that has ever occurred to the human race. It is indeed a most lamentable fact that Physiologists have almost universally embraced the odious doctrine of Materialism, which seems destined to be fraught with more wide-spread ruin to the human family than the fall from rectitude of our first Parents. Its tendency clearly is to estrange man from his Creator, by withdrawing his attention from his immortal spirit, and enchaining it to his body, which his reason leads him to regard as mortal and perishable. It impairs or destroys our reverence for the Deity, by degrading him from his high character of Lawgiver, Ruler, and Governor of the world, to that of a common laborer, whose office consists in constructing microscopic organisms, from whence the other parts of all beings and substances are developed. It is very questionable if the Author of Nature creates any organism whatever, connected with the bodies of living beings. He creates their spiritual parts, and endows them with certain faculties, and impresses on them certain instincts or commands, which prompts them to construct organs suitable for the performance of the purposes for which they are designed by their Creator. They do this, as we have said before, by first forming the nervous system, which brings them into relation with the material world; and by the agency of this nervous system they convert the materials presented to them into tissues and organs. All the actions of every living being are prompted by the instincts or commands of its Creator; and when these commands are obeyed, as he has appointed that they should be obeyed, then his creatures are happy; but if these commands are perverted or obeyed differently from his intentions, or not obeyed at all, then are his creatures unhappy or miserable. This is the condition of all living beings; they are all made free agents, and their happiness and unhappiness is placed at their own disposal. Happiness is made the inducement to a proper



obedience of their instincts, whilst an improper obedience is punished by unhappiness. This view of the economy of Nature becomes a subject of the utmost interest when it is considered that it is applicable to ourselves. We are endowed with nearly the same faculties, perform the same functions, mental and corporeal, as other beings, and have impressed on our spiritual being the same, or similar instincts. 'Tis true that our faculties, at least some of them, as the Imagination, Judgment, &c., are more developed; and our functions, as Reason, Invention, &c., are performed more perfectly than those of brutes; but our advantage over them consists in our capacity to record the results of our Reason and Invention; and thus possessing the facility of communicating these results from one to another; in our capacity to contemplate the operations of the Deity in his works; in the instinct, which seems peculiar to man, that prompts him to give his affections to his Creator, his admiration of his wonders, and his gratitude for the blessings he continually enjoys; in the scheme of Christianity, which contains definite rules to direct him as to the manner he should obey his instincts, and proposes to him as an inducement to such obedience, not only happiness in this life, but a state of endless enjoyment in a future world. The view which I am advocating imparts a new interest to the study of the Natural History of living Beings, by pointing out a new and unfailing principle of classification or orderly arrangement of them, I mean that of their instincts; by pointing out the close connexion between them and their Creator, from an obedience or a perversion of whose commands all their actions originate, and a new interest is possessed by all these actions from a knowledge of their origin. Thus the anatomical structure of the body, the habits, color, voice, habitations, &c., &c., all become subjects of intense interest to the student of Nature, when he is convinced that all these proceed from the immediate commands of the Author of Nature. He thus discovers a rock—

“On which man’s tossing thought  
May rest from ruin, dare his fate survey,  
And nobly think it something to be born.”

The doctrine of Materialism, on the contrary, leads the student of Nature directly to Infidelity and Atheism, by withdrawing his attention from the close connexion that might be observed between the Creator and his creatures. In all our works on Science, it has come to be considered unscientific and unphilosophical, not to say ridiculous, to make



any reference to the agency of the Creator in any part of his creation, and an utter forgetfulness of God is studiously inculcated. Finally, Materialists, by making no allusion to happiness, or to the means of attaining it, either in the present or in a future state, deprive their disciples of the true motives of action, by representing that "the life, after death, which we are to inherit, is to be merely a horrid life of wriggling impurities, originated in the putrefactive mucus."

Sec. 258. The conditions on which vital phenomena depend are, an organized structure, connected by nerves with an intelligent Being. External impressions, as from heat, the life of the atmosphere, &c., may be necessary to cause this intelligent Being to exercise its appointed functions. The position, "that the peculiar properties, which we term vital, are dependent upon the peculiar modes of combination and aggregation of the elementary particles, which are characteristic of organized structures," is utterly false, and unworthy of the consideration of any rational mind. Derangement in function, or irregular action, may result from change of structure, or from external conditions, which causes the Being, instinctively, to determine an abnormal or unusual flow of the nervous fluid to the part affected; but the same unusual determination, producing derangement of functions, frequently arises from impressions made upon the mind by moral causes. If a muscle has been long disused, its owner may find some difficulty in bringing it into action; because the nerves through which the nervous fluid is transmitted, which tubular, may have become from disuse are partially impermeable; and to this same cause may be attributed its change in appearance from imperfect nutrition. Again, convulsive or irregular actions of the Nervous System, are immediately dependent upon the efforts of the mind, although such efforts may, in some instances, be excited by external impressions, which may proceed as well from the circulating fluids as from other sources. The vital actions, or phenomena, may all be explained without the use of the vital properties attributed to the tissues.

Sec. 263. After stating that the operations of the mind are attended with a waste of nervous matter, the author proceeds to say, "from this, and other considerations, we are almost irresistibly led to the belief, that every act of Mind is inseparably connected in our present state of being with material changes in the Nervous System;" "a doctrine," he adds, "not in the least inconsistent with a belief in the separate immaterial existence of the Mind itself, nor with the expectation

of a future state;" in which strain the author indulges on several occasions in the course of his work. But is not this admission in direct contradiction to the remark just now made, "that we gain nothing by the assumption of some general controlling agency, or Vital principle, distinct from the organized Structure itself?" Is it not the whole tendency of the doctrine of Materialism to show that Mind is the result of a peculiar arrangement of the particles of the brain, or of the action of the brain; and is not this supposition inconsistent with the separate existence of the Mind, and with the existence of a future state? It seems to me, that such expressions as we have quoted above, are merely thrown out occasionally by the writer in order to conciliate the multitude, who are naturally led to contrary or different conclusions.

Sec. 259. In the re-union of small portions of the body that have been detached, the restoration of vitality depends on the apposition of the amputated extremities of the nerves of the body to those of the part detached, as by this means their nervous fluid is conveyed to the part, and consequently the nutritious fluids are invited there by the dilatation of the tubes. It is impossible to conceive of a circulation, or of other vital phenomena, without the agency of the nervous fluid.

Sec. 261. The phenomena presented by Plants, are only to be explained by supposing them to be possessed, like animals, of separate immaterial existences, endowed with faculties, and impressed with instincts which prompt their various actions; and that these immaterial existences have for their agent in producing the changes in their own bodies, and in surrounding objects, a fluid analogous to the nervous fluid of animals, circulating through the Pith and Medullary processes, which are clearly the analogues of the Brain and Nerves. Innumerable facts show that they are impressed with instincts; that they adapt means for the attainment of ends, which is a mental function; and that they select their food, which involves sensation, feeling, and consciousness, or will. The changes in their circulating fluids, from the watery sap to the solid, woody fibre, take place precisely as similar changes take place in the circulating fluids of animals, and by a similar agency.

Sec. 265. The action of the alimentary canal or tube, and of all other tubes, is an instance of ordinary muscular action. The peculiarity of such action, consisting in the fact that impressions made on any one point cause or is followed by action, in a normal state, in a point subsequent to that on which the impression is made, in the direc-

tion of the action of the tube; thus an impression made on the fauces, causes or is followed by the dilatation of the upper portion of the œsophagus; when the impression is made by the morsel on this upper portion, the dilatation takes place further along the tube, and so on; the same may be said of the action of all other tubes—the impression of the blood on the Auricle causes or is followed by the dilatation of the Ventricle; the impression on the Ventricle by the dilatation of the Arteries, and so on; but the impressions in all these instances produce action, by inducing the immaterial existence to determine the nervous fluid to the points required; which it does instinctively, when it receives the impression. But if the impression is made by a morsel or substance that it would be improper to receive into or propel along the tube, the action is suspended, by the mind refusing to dilate it. It is difficult, and sometimes impossible, to swallow nauseating medicine, and the Mind obstinately refuses to dilate the lungs or chest when the surrounding Atmosphere is unfit for respiration. Facts of this kind are met with constantly. Plants, as well as animals, select their food; and this fact leads directly to the conclusion that all living Beings are possessed of an immaterial existence, endowed with intelligence; for without this intelligence, we cannot possibly conceive of any proposition that would explain the phenomena. It must be admitted that intelligence is an attribute of Mind, and not, as is sometimes supposed, a property of matter.

There is no active propulsion of the food along the alimentary canal; nor is there any active propulsion of the blood by the Heart. The Medullary processes and pith, and the woody fibres in plants, answer to the Nervous and Muscular systems of Animals.

Sec. 266. Here we have again the fruits of the doctrine of Materialism. The functions are made to depend upon the properties of the tissues; the properties of the tissues upon the condition of the blood; the condition of the blood upon respiration, and so on; it seems to be entirely forgotten by the Materialist, that there is any such thing as an intelligent, immaterial existence or Being, that performs these functions—because it is commanded to do so for the purpose of carrying out the designs of its Creator; although it may sometimes be prevented from performing them by the abnormal condition of the organs or instruments by which those functions are to be exercised. The cases of acephalous fœtuses furnish no argument against our view, but if properly regarded, they confirm it. The taking of food, and applying it to

the growth of the body, shows some, however low, degree of intelligence; the Brain being the organ, not of thought, but the organ intended to give expression to the thoughts, and these thoughts being repressed for the want of the means of expression, the mind itself becomes torpid as it regards its higher faculties, and these become in time almost or altogether obliterated.

The Nervous System becomes affected by a cessation of a due supply of blood, because a large supply of the nervous fluid is derived from the blood, and a large supply of the nervous fluid is constantly being expended on the blood, for the purpose of converting it into the secretions, and into the several tissues.

Sec. 269. A diminution of the nutritious fluids circulating through the system may give rise to an impression originating in the extremity of the nerves terminating in the tubes; which impression, when conveyed to the mind, calls into exercise the actions that are prompted by the instinct that urges us to obtain food. "The mental operations, which have for their object the acquisition of food," are all purely instinctive, as all other mental operations are; and the distinction between these and voluntary acts is unfounded. The difference between the acts of this nature in Man, somewhat advanced in life, and those of infants or brutes, consists in the fact that the former have more fully developed the functions of the Mind, by which he can adopt means to the accomplishment of ends, and is thus enabled to obtain food that would be unattainable by the latter.

Sec. 270. The food received into the mouth is prepared by the agency of the nervous fluid, which is determined to it by the Mind, through the medium of the nerves of the teeth, and those of the salivary glands, when it is united with the saliva; and being thus prepared, it is so constituted that, being presented to the anterior pillars of the fauces, it causes an impression which is transmitted to the Mind; and if the impression be of a proper kind, the Mind determines the proper nervous fluid to the fibres of the fauces, which consequently become actively elongated, and the morsel invited along by the expansion or dilatation of the fauces. Here again another impression is made, and another determination by the Mind of the nervous fluid to the fibres of the upper portion of the œsophagus, which becomes dilated, and again draws the morsel along, at the same time that it is in some degree propelled from its former position by the passive contraction of the fibres of the part from which the nervous fluid has been withdrawn, or has



passed away. This process is repeated until the morsel is conducted through the œsophagus; and, indeed, by the same process, its contents are carried through the alimentary canal; nay, by the same identical process, the passage of their contents takes place through all living tubes. The secretions that are added to these contents as they pass along are nothing more than preparations of the nervous fluid, which are mixed with the contents of the alimentary canal in the form of saliva, gastric liquor, bile, &c.; the object of which is to induce the changes in the circulating mass necessary for the purposes of the economy. The proposition that impressions made on the living body, when conveyed to the nervous centres, are followed by a determination of the nervous fluid, without the intervention of an intelligent immaterial being, is inconsistent with phenomena that are constantly presenting themselves, and is utterly false.

In explaining physiological phenomena, there is no occasion for the use of a vocabulary of technical terms, compounded of dead or foreign languages, which are commonly made use of as a cloak to ignorance, or to exclude from a subject, which is of the greatest interest to all, the consideration of those whose judgments are unsophisticated, and who consequently would be most likely to arrive at just conclusions.

“There is” no “reason” whatever “to believe that the changes which the chyle undergoes in its progress through the lacteals are due to the action of certain *cells*, which are seen to be diffused through the liquid; or that these, by their independent powers of growth, are continually absorbing into themselves the fluid in which they float, &c.; on the contrary, all nature cries out against this dangerous doctrine. This is the starting point, the fundamental principle of Materialism—that all living beings arise from the operations of cells “which have an inherent vitality”—“independent powers of growth”—and are endowed with intelligence enough to construct the bodies of all beings! And this monstrous assumption is here introduced by the remark that, “there is reason to believe!!”

Sec. 272. That the action of the Heart, and the peristaltic movements of the alimentary canal, are quite independent of the agency of the Nervous system, is an assertion contradicted by the plainest dictates of Reason, which lead directly to the conclusion that all action in living bodies are effected by the agency of the nervous fluid; for it is this fluid alone that brings the immaterial existence, called the Mind, into relation with the material world; and without its agency we can neither receive nor produce any impression whatever.



Sec. 275. The office of the lungs is the absorption of life from the atmosphere in the form of oxygen, and the giving off the life of the individual in the form of carbonic acid gas; and the office of the liver is to allow the nervous fluid to unite with the blood, and convert it into bile; and then the life of this secretion to be taken up to supply the waste of the nervous fluid. The slow combustion which is said to take place in the tissues of the living body has no existence except in the prurient imaginations of Materialists. Animal heat is a secretion formed by a peculiar combination of the nervous fluid, and is always in a direct ratio with the quantity of nervous fluid at the command of the individual.

Sec. 276. "The chief function of the kidneys is" to form a secretion, from which, as from all the other secretions, nervous fluid or the life of the animal is derived; and the urine is stored up temporarily in the bladder, that this object may be the more effectually accomplished. The urine in the bladder is also constantly receiving the nervous fluid from the nerves of this viscus, according to the great law of Nature, which has appointed that all things should constantly receive and give off the subtle fluid, life; and the same may be said of the urine as it passes along the Urethra to be voided.

Sec. 277. The special function of the Lymphatics is to continue the circulation of the secretions, in order that they may be the more fully exposed to the action of the nerves referred to above.

Sec. 278. Animal heat being a peculiar combination of the life or nervous fluid of the individual, it is of course regulated by the expenditure of the nervous fluid on the secretions. External heat, when applied under favorable circumstances, makes an impression which causes a preternatural determination of the nervous fluid to the skin, and consequently an increased secretion of the perspiration. The agency of cells in secretion, and selective secretion and selective absorption, is all nonsense; for it is giving intelligence to cells to which they have no claim whatever.

Sec. 279. The process of secretion cannot be rationally explained with any other supposition than that of the agency of the nervous fluid, and the attempt to refer it to the agency of cells is supremely absurd. The action of the excretory tubes were explained when speaking of the action of tubes in general.

Sec. 280. It is not philosophical to distinguish between the functions, calling one set Organic, and making it independent of the Nervous

system; and the other set Animal, which is dependent on the agency of the Nerves. All the functions in an individual are properly referable to the agency of one intelligent, immaterial existence, which has constructed the organs by which the functions are performed, and operates on these organs by means of a single agent, the nervous fluid. The formation of cells may be one step in the formation of the tissues belonging to those composing these organs; but the endowing these cells with intelligence, and attributing to them powers such as Materialists award to them, is perfectly preposterous.

Sec. 281. The function or process of Reproduction is entirely distinct from that of Nutrition, notwithstanding the assertion to the contrary made by Materialists. In the former, a new immaterial being "is begotten, not made," by cells, endowed with certain distinct faculties, and impressed with certain instincts or commands, which are to regulate its future actions. Whether such a being is a natural result of some mysterious union of Mind with Mind, or the act of one Mind; or whether each being is produced by a special act of Creation, is left a question undecided; it is sufficient for the purposes of the Physiologist to know, that such a being is formed with such faculties and such instincts, and it is his province to trace the actions arising from these instincts. Nutrition is nothing more than an act prompted by one of these instincts.

It suits the purpose of the Materialist, in order to make his doctrine consistent with itself, to make "*Reproduction consist in the formation of a cell, which can give origin to others, from which again others spring; and in the capability of these last to undergo SEVERAL kinds of transformation, so as ultimately to produce a fabric, in which the number of different parts is equal to that of the functions to be performed, every separate part having a purpose distinct from that of the rest!!!*" If the cells can do all this—if they can adapt means so nicely to the attainment of ends, and this, too, through a long series of steps, which act presupposes a highly developed Reason to become acquainted with the laws by which these ends are to be attained—then must these cells be possessed of an intelligence equal to that of the Deity himself. For we contend that no creature could do all this without the guidance of the Creator, which he gives by means of the instincts. Let it be constantly borne in mind, that in this system of Materialism no mention is ever made of the Deity, and no reference whatever is made to the agency of the Creator in any part of the Crea-

tion; except perhaps occasionally, and in very rare instances, to admit that he creates some microscopic organism, perhaps the nucleus of a cell.

I have not the mental capacity to perceive the lucidness of the remark, that "the Nervous system lives and grows within an Animal, as a Parasitic Plant does in a Vegetable; with its life and growth certain sensations and mental acts, varying in the different classes of Animals, are connected by nature in a manner altogether inscrutable to man; but the objects of the existence of Animals require that these mental acts should exert a powerful controlling influence over all the textures and organs of which they are composed;" but, on the contrary, this whole sentence seems to me to be involved in the most impenetrable obscurity.

Sec. 283. I protest, at the outset, against the assumption that action in the living body consists in the *contraction* of its fibres. Contraction of the fibres is caused by the individual determining the nervous fluid *from* the fibres to its nervous centres; and the action, in such instances, is *in these centres* and not in the fibres. The active state of a muscle, or of its fibres, consists in their *elongation*, which is effected by the presence of the nervous fluid, *determined to them* by the individual. Sensation and motion belong to Plants as well as to Animals, although the former are not commonly capable of locomotion. The Pith and Medullary processes evidently perform the same office in Vegetables as the Nervous system in Animals. The insisting upon the observance of a rule—"non fingere hypothesis"—which the author says is well known in philosophy, and which he says cannot be too steadily kept in view in prosecuting physiological inquiries, comes with an ill grace from a Materialist. What is Materialism but a feigned hypothesis, unfounded on any fact in nature, and yet fraught with greater evil and with more horrible consequences to the Human race, than any hypothesis that has ever been concocted by the wildest imagination of Man.

The time has passed when the human mind could be trammelled by the rule just referred to. It is too late in the day to advance the doctrine that one or two individuals are to have the exclusive privilege of exercising the function of reason, when all are known to possess the same privilege by a charter from God; when it is known that, in exercising reason, we are necessarily compelled to suppose an hypothesis, in order to find out any truth; and when all claim the right to exercise their own judgment on any proposition or hypothesis submitted to it, in order to decide whether it be true or false.

Sec. 285. The observation that "every method at present known, by which mind can act upon mind, requires muscular contraction for its medium, and sensation as its recipient, means simply what I have before advanced, namely, that we can neither make nor receive an impression but through the agency of the nervous fluid.

The remarks about "the general scheme of man's probationary existence," and "that in a future state of being the communion of mind with mind will be more intimate," &c., &c., are here introduced again at a reasonable interval, merely to keep way with the unreflecting; for, I again insist, that the materialist is incapable of perceiving the true relation of the creature to its Creator; and what is of still more importance, he is, from the nature of his opinions, utterly incapable of perceiving any ground on which to found a belief in a future state. If the reproduction of a living being is the work of nutrition, and the formation of the body, in which it is believed that the personal identity of such being consists, be the work of cells; and if the mind be the result of the structure of the brain; or, in other words, if the brain be the organ of thought—then must the Materialist inevitably come to the conclusion that the existence of a God, with whom he is so distantly connected, is a matter of but little interest to him; and, further, that the existence of his mind depending upon materials which his experience teaches him to be perishable, when these do perish, then his mind must be annihilated, and, of course, that a future state is altogether imaginary.

Sec. 286. Light, sound, and odors, are but forms of life or peculiar combinations of the subtle fluid which we have said was the basis of matter, and which we propose to call life. The nerves of the senses are each separately adapted to receive one of these forms of life, and transmit it to the centres to be perceived by the individual; the nerves of sight to receive light; the nerves of hearing, sounds; and nerves to smell, odors; but in order to transmit these forms of life, it becomes necessary that the nerves should be rendered permeable by a determination to them of the nervous fluid of the individual, and this determination is always made when the senses are exercised, and is what is meant by the expression, giving the attention. The minutiae of the anatomical structure of the organs of the senses are calculated to prepare impressions, or the subtle fluid making them for transmission through the nerves. We have heretofore adverted to the fallacy entertained by the author in relation to contractility, to muscular action, and to its independence of the Nervous system.



Sec. 289. The account given by the author of the arrangement of the tubular fibres of nerves is incorrect. These are very properly divided into two sets—the afferent, destined to convey impressions from the periphery *to* the centres or ganglia, (and these impressions are nothing more than the subtle fluid which we have said is ever passing from all material objects;) the other set of nerves is called efferent, and convey the nervous fluid *from* the centres to the periphery. The error referred to consists in representing the afferent nerves as being distributed only to the sensory surfaces or organs, and the efferent nerves as distributed exclusively to the muscles; whereas the truth is both sets, the afferent and efferent, are distributed to the sensory surfaces and organs, and both sets are likewise distributed to the muscles and other fibrous tissues.

Another important error in this paragraph it may not be well to pass unnoticed. The efferent nerves are represented as conveying the *nervous influence*, which means nervous fluid, to the muscles which are thereby thrown into contraction, which is supposed to be the active state of the muscle. This statement is untrue; the nervous fluid, when conveyed through the efferent nerve to a muscle, causes its *elongation*, which is in fact its *active* state; and the contraction of a muscle, which is in reality its *passive* state, is caused by having its nervous influence or nervous fluid conveyed *from* it by means of the afferent nerves, which convey it to the nervous centres.

The ganglia I suppose act as so many hearts in circulating the nervous fluid, and thus give the mind a greater or more efficient control of this fluid by facilitating its circulation.

Sec. 292. The reasoning here is extremely imperfect, and the conclusion arrived at may be substituted by another, which furnishes a more rational explanation of the facts. A large portion of the nervous fluid is derived from the blood; the more as it becomes assimilated and vivified by the action of the nerves upon it, and of the atmosphere in the lungs; and from this fact it is easy to see that “the activity of the nervous system is not merely dependent upon a constant and ample supply of blood; but that it requires that this blood should be in a state of extreme purity,” that is, that it should contain its due share of materials ready to pass into the nerves. The conclusion that “*the functional activity of the nervous system is mainly dependent upon the combination of the oxygen supplied by the blood, with its elements,*” is an essential proposition in the doctrine of Materialism, but

is not entitled to rank as a Physiological truth. The production of the nervous force (if the expression has any meaning) is not a result of any change of composition, but is referable to the agency of an immaterial existence.

Sec. 293. The attempt made by Materialists to explain what are called the phenomena of life, without the agency, direct or indirect, of any immaterial Being, has led to a complicated, confused, and unintelligible explanation of these phenomena, such as is contained in the following paragraphs :

When a number of facts or instances are presented to our observation, it is philosophical to arrange them so as to bring them readily within the comprehension, and to infer from them propositions that are practical, that is, that may enable us to exercise our invention, or the function by which we adapt means to the attainment of ends ; and any proposition thus found, provided it enables us to exercise this function, may be received as a truth, if not inconsistent with other known truths. From the known phenomena presented by living beings I think we may infer, that there is a subtle fluid called the nervous fluid, which circulates through the nerves and nervous centres, as the blood through the blood vessels and heart; and again, that this fluid is under the control of an immaterial Being, which it makes use of under the guidance of another immaterial Being, who is the Creator and Supreme Governor of the Universe ; that this guidance is effected by means of the instincts or commands impressed on these creatures at the moment of their creation. Admitting the truth of these general propositions, we are enabled to understand many phenomena which are otherwise unintelligible, and we are further enabled by them to adapt means for the attainment of many important ends which we could not otherwise attain. For instance, we may make use of these propositions to enable us to employ means to counteract the deleterious agency of disease upon our bodies; and they enable us to see more clearly the reasonableness of the truths of Christianity, and thus lead us to make use of the means it inculcates, in order to attain to a state of future happiness.

Sec. 297. Electricity is a subtle fluid which permeates inanimate matter, and, of course, is not identical with the nervous fluid which belongs to animated bodies, although it may make impressions on the latter bodies.

Sec. 299. In every trunk of nerves, afferent as well as efferent fibres

are bound up; and the irritation of the trunk may cause action in the afferent fibres which withdraw the nervous fluid from the muscle, and thus cause its contraction; but it would not cause a determination of the nervous fluid probably to the muscle, because the attention of the individual would be limited to the point at which the irritation was made.

Sec. 300. Experiments made to determine the function of nerves are entitled to no credit, from the fact that they have all been made under the false impression that the contraction of a muscle is the result of a *determination to it* of the nervous fluid, or, as it is said, of the nervous influence; when the truth is, that this contraction is the result of the withdrawal *from* the muscle of the said fluid or influence.

Sec. 307. 1. There is no distinction in reality between voluntary and involuntary acts, (both proceeding from the instincts,) unless it be that in the latter impressions are more immediately followed by the act of the mind determining the nervous fluid where its presence is required; whereas in voluntary acts the operation of the mind is perhaps more deliberate, and is preceded by the exercise of the mental function called Invention, or that function by which we adapt means to the attainment of ends: thus, when the odor from its mother's breast makes an impression on the infant, and awakens its appetite for food, it immediately seizes upon the nipple, if presented to it; but the adult, when his appetite for food is excited, sets himself to work to adapt means for the attainment of food, if it is not at hand, or makes use of his faculties to bring it within his reach.

2. The reflex function I have explained in a former note; which explanation has proceeded from my own reasoning, without any reference to any thing written on the subject. The error committed by Dr. Hall in his investigations, consisted in his attempt to explain the phenomena by the use of mechanical principles alone, and without any regard to an intelligent Being; the impression made on a centre was followed by an immediate determination of the nervous influence from that centre, without even the intervention of the will. But this blind act of the centre would not account in any satisfactory manner for the phenomena. Take, for example, the instances of reflex action exhibited in the Circulation of the Blood; when an impression is made on the left Auricle of the Heart by the vitalized blood from the Lungs, this impression is conveyed to the nervous centre, and is followed by an active dilatation (not the contraction) of the left Ventricle; which

active dilatation, by forming a vacuum, draws the blood from the Auricle into the Ventricle, when, at the same time, the active state having passed from the Auricle, it assists the motion of the blood into the Ventricle by its (the Auricle's) passive contraction. The impression made on the left Ventricle by the blood flowing into it, is followed, in like manner, by a simultaneous active dilatation of all the arteries of the general system; and so the action is carried forward, from one point to another, throughout the whole circulation. The difference between Dr. Hall's views of reflex action (which, by the by, he has never applied to the action of the tubes, or to the circulation of the blood) and mine, consists in this, that he refers the acts simply to the nerves, nervous centres, and muscular fibres, engaged in the operation, and considers them merely as the result of the operation of certain properties inherent in these parts, which takes place in accordance with certain general mechanical laws; while, according to my views of this reflex action, it is the result of the determination of the nervous fluid, by an intelligent Being, which receives the impression from the blood, and dilates the different parts, as we have seen, for its circulation through the system, in accordance with a command which it has impressed upon it by its Creator. Which of the above views is the correct one, may be decided when it is seen which of them leads to the most important practical application; or which will enable us the most certainly to adapt means for the attainment of ends, or to make use of means for the preservation of health and the alleviation of disease.

Sec. 311. One of the greatest obstacles to a clear view of the nervous function, is the assumption (altogether gratuitous) that Plants have no part of their system corresponding to the nervous structure in Animals. But I do not see how Physiologists can possibly shut their eyes against, or withdraw their observation from, the very striking analogy to the Nervous system presented in the Pith and Medullary processes of Plants. The arrangement of the latter is very similar to that of the Nervous centres and Nerves; and the anatomical structure differs from that of other parts of the Plant, as the anatomical structure of the Nerves differs from any other structure in Animals. The sole objection to the acknowledgment of a truth so obvious and palpable to the senses, seems to arise from the fact, that such an admission might lead to conclusions inconsistent with the established views by which the distinction is drawn between Plants and Animals. This distinction, as laid down by Physiologists, is, that Animals are possessed of a will, of



sensation, and of motion; whilst Plants have none of these, simply because they have no Nervous system, which is the instrument of these faculties, and without which they could have no existence. But, if it be admitted that Plants have a Nervous system, or something analogous, then this distinction (on which Physiologists seem to plume themselves) could not be drawn. The truth is, that we have the very strongest proof (the evidence of our senses) of the fact, that Plants are possessed of volition, sensation, and motion; and this fact furnishes a convincing argument in favor of the opinion, that the Pith and Medullary processes in Plants are the analogues of the nervous centres and Nerves in Animals; and this fact, together with another known fact, namely, that Plants have instincts which regulate their actions, completely establishes the truth that Plants, like Animals, are possessed of a separate immaterial existence, whence all their actions immediately proceed.

Sec. 313. If we have the right to infer (as we undoubtedly have) from the phenomena presented in the Hydra, that they are possessed of a Nervous system, why have we not the same right to infer, from similar phenomena presented by Plants, that these are possessed of a system analogous to the Nervous system, which could be no other than the Pith and Medullary processes? The tentacula in Hydra do not (when particles of food are conveyed by them to the orifice of the stomach) contract throughout, as the text would seem to intimate; but having longitudinal fibres arranged on every side, the fibres of one side are actively elongated, whilst those on the opposite side are passively contracted; and thus the extremity of the tentaculum is bent over, and this action of several united brings the particle of food to the orifice of the stomach; no individual tentacle being even shortened while the animal is feeding.

Sec. 316. Tunicata.—The water is drawn into these animals by the active dilatation of the sac, and is expelled by its passive contraction. Any rough impression made on the tentacula, or on the surface of the sac, causes the animal instinctively to withdraw its nervous fluid from the fibres of its walls to its nervous centre; and, consequently, the impression is immediately followed by the contraction of the walls, and the expulsion of the water they enclose. When the animal is actively engaged, as in feeding, the fibres, both of the tentacles and sacs, are elongated; the tentacles consequently extended, and the sac dilated. The office of the Cilia has been explained in a former note, sect. 172.

The actions of this animal, by which it contracts its tunic, are simple, and not reflex.

Sec. 336. Those acts that are performed by all the individuals of any one species of living Beings—the act of one Being being precisely similar to that of another—may be called purely instinctive; that is, they all proceed immediately from the command of the Creator, impressed upon the mind of the individual, and are not preceded by the exercise of Reason and Invention. Thus, the taking of food, or the manner of taking it; the manner of reproducing the species; the migration of animals; the building of nests by birds; the peculiar sounds given off by the various species of animals; their peculiar secretions, are all purely instinctive acts, because they are not the result of the exercise of Invention, or the function by which means are made use of for the attainment of ends; these acts are performed without any reference to the ultimate object to be attained. Of this nature are the acts of the honey bee, in constructing its comb and storing up its honey. It is prompted to perform these acts by its instincts, and they are performed without reference to any ulterior object. Man, in constructing his habitation, and in making provision for the future, first exercises his Reason, and then his Invention, by which he adapts means for the attainment of special objects.

The adaptation of means to ends is not the result of Reason, as stated in the text, but it is the result of the exercise of a different function—that of Invention.

The acts which I call purely instinctive, and which the author terms "*consensual*," do not take place, however, as he would have us suppose, without the intervention of the will or Mind; but, on the contrary, these, as well as all other acts of living Beings, are prompted by the instincts impressed on the Mind, and are the immediate acts of the Mind itself.

Sec. 359. The semblance of the human fœtus, in its different stages of development, to the permanent forms of animals, lower in the scale of being, is altogether fanciful and fabulous; like the ridiculous dream of Gœthe, which has been greedily caught at by Naturalists, namely, that all the productions of plants, such as flowers, carpels, fruit, &c., are metamorphosed leaves. The indulgence of a morbid Imagination in investigating the subject of Physical science, leads to no valuable result whatever, and should always be discountenanced by inquirers after truth.

Sec. 368. The arguments made use of by the author to establish the point, that reflex actions are independent of sensation, are all false; because they proceed on the false assumption, that the action of muscles consists in contraction, or that innervation causes the contraction of muscles. The instances mentioned in this paragraph have no bearing upon the point at issue, because they are not instances of reflex action at all. The convulsion or contraction of the muscles arising from comparatively slight irritation, was owing to the fact that such irritation, by acting on the nervous centre, caused the person to determine the nervous fluid from the muscles to the centre, and consequently the muscles became contracted, or were thrown into convulsions. This view is confirmed by the fact mentioned, that the individual, by extending his muscles by an effort of the will, that is, by determining the nervous fluid to the muscles, was enabled to overcome these involuntary contractions, and to walk.

Sec. 380. The purpose for which the several acts of sighing, yawning, sobbing, laughing, coughing, sneezing, crying, &c., are performed, is to get rid of accumulated nervous fluid, which has not been regularly expended immediately preceding these acts; from the circumstance that the mind has been occupied, either by some source of irritation in the system, or by some of the emotions, or passions; which latter are nothing more than the emotions or affections unduly exalted by means of the Imagination. Yawning, for instance, is caused by an accumulation of the nervous fluid, resulting from the Mind's ceasing to give its attention to the distribution of the nervous fluid to parts of the system otherwise constantly receiving it during the waking state; to the Brain, for instance, for the expression of thought; or to the senses, which at such time are disposed to suspend their functions, as in sleep.

Sec. 382. The act of deglutition has already been explained, sect. 270. The active stages in the process consist in the dilatation, and not in the contraction, of the fauces and the several portions of the œsophagus; and these acts evidently proceed from the immediate agency of an intelligent being. Matter of itself has no intelligence, neither is it capable of independent action.

Sec. 387. The Sphincter muscle of the Cardiac orifice of the stomach is opened, not by pressure, but in consequence of an impression made either on the lower portion of the œsophagus, as in deglutition, or on the Cardiac portion of the stomach, as in vomiting. All Sphincter

muscles, in their natural state, or state of repose, close the tube or passage about which they are placed, and it is by a preternatural determination to them of the nervous fluid, causing the elongation of their fibres, that these tubes or passages become dilated.

Sec. 388. The Hallerian doctrine, that the muscular fibre possesses, in itself, the property of contractility, which the author unhesitatingly adopts, is not supported by any facts mentioned in this paragraph; inasmuch as it is assumed that muscular action consists in contraction, which has been shown to be utterly false. The contraction of the intestines may well take place when separated from their connexion with the nerves, for we have said the loss of the nervous fluid is always the cause of contraction. The dilatation of the intestines, under similar circumstances, may depend on the motion of the contents in consequence of the contraction in other parts of the tube.

Sec. 389. The intestinal tube, from the stomach to the rectum, is certainly dependent for its action on the nerves connected with the spinal cord.

Sec. 390. The action of the urinary tube or canal, including the bladder, is precisely similar to that of the alimentary canal. The impression made on the ureters by the urine as it passes through them, is followed by the dilatation of the bladder, dependent on a determination to the fibres of its walls of the nervous fluid; and this dilatation is, in a normal condition of the viscus, in a direct ratio with the quantity of urine flowing into it. When the urine has passed into the bladder, and undergone the changes it is appointed to undergo there, that is, has given off and received nervous influence, it makes an impression which is followed by the dilatation of the sphincter of the bladder, by the individual withdrawing the nervous fluid from the fibres of the body and fundus, and determining it to the fibres of the sphincter—the contraction of the body, and fundus of the bladder, then is in a passive state, resulting from the withdrawal of the cause of action—the nervous fluid. That the determination spoken of is made by the mind, or individual, is proved by the fact that we can, in many instances, relax the sphincter, and discharge the urine voluntarily, without awaiting the impression on the bladder. The passage of the urine along the urethra, is effected by the alternate dilatation and contraction of portions of the tube, in the same manner as the passage of the morsel takes place through the œsophagus.

Sec. 391. In the acts of defecation and urination, a draft is made



on the whole system for nervous fluid, but especially on the abdominal muscles, and those concerned in respiration, for the purpose of supplying the demand necessary for the dilatation of the tubes, and especially of the sphincters concerned in these acts. This circumstance furnishes a clear and simple explanation of the contraction of these muscles on such occasions.

Sec. 392. The assistance given to the sphincters to enable them to resist the expulsion of the contents of the tube, consists in increasing the action of the nervous centres, and thus preventing the determination to them of their cause of action, which, by elongating their fibres, would effect their relaxation, or rather their active dilatation. This is proved by the fact, that if the action of these centres be diminished, or lessened by any cause, such as the depressing passion of Fear for instance, the contracted state of the sphincters cannot be maintained.

Sec. 393. The arguments in this paragraph show to what lengths the author allows himself to be carried, in order to support a favorite hypothesis. To prove that the ejacutio seminis is unattended with sensation, and consequently, that it is independent of the Nervous system, he brings forward the testimony of one Brachet, who "mentions a case of this kind in the human subject, in which the patient's own testimony could be adduced!!!" What credit is due to the statements of a writer who could undertake to prove, with such feeble testimony, that there is no sensation connected with an act, which, according to the experience of every one who has ever experienced it, is accompanied with the most ecstatic of all sensations—is left to be determined by his readers.

The emissio seminis takes place precisely as the other actions of the tubes of which we have spoken; the secretion of the semen, and the preparation of the fluid in the vesicula seminales, furnishes the impression necessary to give rise to the action resulting in the emission. The same explanation applies to the action of the uterine tube, embracing the uterus itself. The impression made by friction, and by the male semen, gives rise to an action, which, commencing in the Vagina, terminates at the extremity of the Fallopian tube, by which means the semen is conveyed to the ovaries; and, again, the impression from the impregnated ovum gives origin to the series of actions in the Fallopian tube, beginning with the embrace of the ovaries by its extremities, the corpora fimbriata, and ending in the delivery of the ovum within the cavity of the uterus.

This view of tubular action furnishes the key to a simple and ready explanation of one among the most important functions, and certainly the one least understood of any of the functions of the animal economy—I allude to Parturition. The fœtus, in a normal state, having arrived at a proper stage of development, makes an impression on the uterus, which is conveyed by the nerves to the mind of the mother, who instinctively performs the series of acts that result in the expulsion of the fœtus, or birth of the child. The impression being made on the body and fundus of the uterus, she determines the nervous fluid to the fibres of the cervix and os uteri, which, by this means, become dilated, or as it is commonly termed, relaxed. The nervous influence having by this act been withdrawn from the body and fundus of the uterus, these latter contract simultaneously with the dilatation of the cervix and os uteri, and thus the fœtus is brought into contact with the latter. The impression by the fœtus, at this stage of its progress, is followed by a determination of the nervous influence to the fibres of the vagina; and again that tube being dilated, and the cervix and os uteri consequently contracted, the fœtus is moved another step in its progress. Finally, the impression made by the fœtus on the vagina, is followed by the dilatation of its external orifice, together with the contraction of the walls of its superior portion, and the fœtus is, by this joint action, expelled.

Sec. 394. The action of the spinal cord is the same on the sphincters, as on all other muscular fibres. The action of the orbicularis muscle in movements of the eyelids is misrepresented; the contraction of this muscle upon the irritation of the margin of the tarsus, is not an instance of reflex action, but is direct, and owing to the action of the corresponding nervous centre, which, when the impression is made on the tarsus, withdraws the nervous influence from the fibres of the muscle. The opening of the eyes is effected by the preternatural determination of the nervous fluid during the waking state, which determination ceases in sleep, or when the eyes are closed.

Sec. 395. The closure of the pupil against a strong light is an instance of reflex action. The closure is not effected by any sphincter fibres, as the author seems to suppose, but by the active elongation of the longitudinal fibres of the Ciliary processes, which follows the impression made by the strong light, as we have seen in all other instances of reflex action excited by impressions.

Sec. 397. The action of the muscles concerned in locomotion is

precisely similar in itself to that already explained. The exciting cause, however, is volition, or originates in the Mind, and not in any external impression. The impulse, or that which propels the body along, it should be recollected, is the active elongation of certain muscles, by the determination to them of the nervous influence; and this is done at the expense of certain other set or sets of muscles, which have their nervous influence withdrawn, and are thereby contracted. The same may be said of the muscles of the upper extremities; of the hand, for instance, in the act of closing or grasping a solid body. The muscles that are in a state of action in this movement are, contrary to the received opinion, the *extensors*—which are actively elongated by the nervous fluid, which has been withdrawn for this purpose from the *flexor* muscles, which flexor muscles are thereby contracted. Consequently, this contraction is passive, and not their active state, as is commonly supposed.

Sec. 398. The tension, or state of partial contraction, observed in the fibres of the living body, depends on the action of the nervous centres, which control or regulate the condition of the fibres, by regulating the supply of nervous fluid. When these centres are destroyed, as in the instances cited, this tension is of course lost, or ceases. By what has been said, I mean that the centres are the instruments that the Mind makes use of to control the supply of nervous fluid.

Sec. 401. Tetanus is a disease of the nervous centres, resulting in a highly irritable condition; a slight stimulus applied in this state causes a preternatural action in the centres, and consequently an extraordinary revulsion of the nervous energy from the muscles, which is the immediate cause of their contraction. The effect of the Tincture of Cantharides in the case related by Dr. Hall, was merely to determine the nervous influence to the bladder, which caused its expansion, and the retention of the urine. The phenomena connected with the frog, as related under the supposition that there is, at the season of copulation, a preternatural determination of the nervous fluid to the organs concerned, or engaged directly, as well as indirectly, in the act—the grasping with the interior extremities is owing to the active elongation of the extensor muscles. The enlargement of the thumb is attributable to the same determination.

Sec. 419. The author here mentions a fact, which becomes important when placed in connexion with my view of muscular action. Speaking of the hypoglossal nerve, he remarks, “when this nerve is

paralyzed on one side in hemiplegia, it will be generally observed that the tongue, when the patient is directed to put it out, *is projected towards the palsied side of the face;*” “this is due,” he adds, “*to the want of action of the lingual muscles of that side, which do not aid in pushing forward the tip.*” Now, this explanation happens to be true, and is exactly in accordance with my view, in which I consider the action of muscles to consist in the active elongation of their fibres. The action of the fibres on the sound side would tend to protrude the tongue, but the want of action on the paralyzed side of the tongue would cause the projection of the organ towards this side—the action of the side being “unantagonised by their fellows.” *If the action of muscles consisted in contraction, it is evident the projection of the tongue would be in a contrary direction, or towards the sound side, where the fibres, if in a state of action, would be contracted.*

Sec. 428. All the actions of all living beings are *instinctive*, that is to say, they have their origin in an inherent impulse, and this impulse originates from the command of the Creator. This world is evidently formed in accordance with some vast scheme, and living beings are placed here in order to perform an appointed part in this scheme. To direct them as to what is required of them, commands have been issued, and have been stamped upon the immaterial existence which constitutes the personal identity of every such being. These instincts are impressed upon them, at the same time that they are endowed with faculties, capacities, and affections. If obeyed according to the will of the Designer, these commands serve to guide us, as well as all living beings, to happiness; if disobeyed or perverted, they lead as directly to unhappiness and misery. The world is so constituted that happiness is proposed as the reward of obedience to the will of the Creator; and, on the contrary, unhappiness is the punishment appointed for the disobedience of his will. The reward is appointed to induce creatures to carry out or promote the designs of the Creator; the punishment is intended to deter them from marring his designs. The slightest attention to what is passing around us, will be sufficient to lead to an acknowledgment of the truth of these conclusions.

Of the instincts some may be called determinate, because they lead or direct to a certain series of acts resulting in the attainment of some specific object.

Of this kind are those acts commonly regarded as peculiar to the lower order of animals, such as the construction of the comb by the



honey bee, the building of nests by birds, &c. We shall see, however, that the determinate instincts are common to man and brutes.

The general instincts are those which prompt to the exercise of the mental faculties and functions, and of the affections. As instances of these instincts we may enumerate the exercise of reason and invention, which perhaps contribute more to the welfare of mankind than any other of the instincts—the results of their exercise having a more extensive operation, or a wider bearing upon the human race generally, than that of any other of the instincts; besides this, the exercise of reason and of invention, or obedience to the instincts which prompt these exercises, is rewarded with perhaps the purest and highest pleasure or happiness of which the human mind is susceptible.

The exercise of the determinate instincts is commonly attended with peculiar conditions and the impressions made by these external conditions on the mind of the being may be regarded as the exciting cause of such exercise; the impressions made by the odor of flowers, or other odors, cause the bee to call forth its energies, which are directed towards the formation of its comb; and the warmth of the season arouses in spring the dormant faculties of the birds, which are busied in constructing their nests and rearing their young.

Sec. 429. The attempt to draw a line of demarkation between instinct and intelligence is futile. The instincts are as much a part of the intellect as the mental faculties; I mean to say, they belong to the mind and are stamped upon it. Bees are not tied down to any line of action by the constitution of their nervous system. The assertion that they are is gratuitous, and is founded in an utter ignorance of the economy of nature. Bees are possessed of determinate instincts, one of which prompts all bees to construct a comb, and another to work together for a common object, &c.; they have also been observed to be guided by a general instinct, as that of exercising invention, or adapting means for the attainment of specific ends. The shape and direction of the comb have been seen to be varied to suit the peculiar circumstances under which it was built. A piece of glass thrust into a hive has caused the bees to vary the comb from the perpendicular in which they were building it; and this was done by giving a peculiar and unusual shape to the individual cells.

Sec. 430. All the actions of animals are evidently referable to the immediate directing influence of the mind and not of the sensations, which latter idea implies an absurdity.

The reflex actions are all instinctive, and belong to the class we have called determinate; as also are vomiting, sneezing, laughter, &c., photophobia, hydrophobia, hysteria.

Sec. 437. The emotions or affections are endowments of the mind, and to treat of them, as the author does of these, as well as of all other vital acts, without any reference to the immaterial existence, is, to my mind, supremely absurd. The mind gives expression to the affections through the medium of certain nerves operating on certain muscles, &c. In the exercise of the affections, there is a greater or less determination of the nervous fluid to some of the viscera. The organs of respiration, the heart, stomach, and liver, are some of the viscera which suffer from such determination. The passions, it may be remarked, are merely the affections or emotions preternaturally exalted by the agency of an excited imagination. Thus anger, love, fear, &c., become passions only when thus exalted.

Sec. 438. I have heretofore explained (Sec. 394,) the action of the Sphincters in a manner entirely different from the explanation of the author. Fear is a depressing passion, and, when carried to a certain extent, paralyzes the mind, and renders it incapable of performing the most ordinary acts; it cannot support or continue the action of the nervous centres so as to retain the sphincters even in their modern state of contraction; but the expansive power of these centres ceasing altogether, the nervous fluid flows to the fibres of the sphincters, these become elongated, the tube or neck of the receptacle dilated, and its contents discharged. This effect of fear is evinced in man as well as in the lower animals.

Sec. 440. The instances mentioned of melancholy and mania may be referred to a loss of balance between the faculties of the mind—the imagination being morbidly developed at the expense of the judgment.

Sec. 443. There is no sphincter of the iris. The pupil is contracted or diminished by the agency of the longitudinal fibres of the Ciliary processes, which become elongated when in a state of action, and thus tend to close the pupil, or reduce its diameter. The contraction or inactive state of the same fibres tends to dilate the pupil, or increase its diameter; the contraction of the pupil is properly represented as an instance of reflex action—using this term in its proper sense; the impression of a strong light being made on the retina is conveyed to the mind, and the mind instinctively determines the nervous fluid to the longitudinal fibres, spoken of, which, becoming elongated, close the pupil, and the injury that might result from too much light is avoided.

Sec. 444. The contraction of the orbicularis muscle is effected by the action of its corresponding nervous centre, by which means the nervous fluid is withdrawn from the muscle. This is not an instance of reflex action.

Sec. 471. The very unsatisfactory account given by the author of the function of the Nervous system is attributable to the very confused notions entertained in regard to the nature of this portion of the animal economy. This system is not, nor is any part of it, the instrument of the reasoning faculties, nor has it any control over the vital actions in itself. The reasoning faculties, by which expression I suppose he means the mental faculties, belong exclusively to the immaterial existence; and so does the control over all the vital actions, whether those called vegetative, or over those called animal. The Nervous system is the instrument the mind makes use of to attain its various objects, or to effect various changes in the material world; but it is in no other sense an instrument of the reasoning faculties. The older anatomists were correct in considering motion and sensation, as well as all other vital acts, as immediately dependent upon a subtile fluid, which they termed "animal spirits," propagated from the brain, and they might have added, from other nervous centres; but the mistake committed by them, in common with modern physiologists, consists in attributing this propagation of the fluid to the agency of these parts themselves; instead of referring it to the agency of the mind, which uses these organs, the nervous centres and nerves, merely as the instruments or channels through which to transmit the fluid. The monstrous folly admitted into physiological science is the attempt to explain vital phenomena without any reference to the real agent, the mind, by which these phenomena are brought into existence. The same folly exists in chemical science, in taking no cognizance of the subtile fluid, Life, which is the real agent in producing the changes about which that science is conversant.

I conceive, as I have before stated, that the vesicular matter observed in the brain, and other nervous centres, performs the office of a gland, wherein the nervous fluid undergoes some change in order to bring it to its perfect state—ready to be used for the purposes required in the economy; or it may be that this vesicular matter is the receptacle for storing up the nervous fluid for use in any emergency, or for any extraordinary demand. We know that, whenever any extraordinary exertion is to be made, there is, immediately preceding the act, a with-

drawal or determination of the nervous fluid from the periphery to these centres, and it is retained there temporarily, and then concentrated upon the organ or organs brought into action.

Sec. 476. We have said that a large portion of the nervous fluid was derived from the secretions. May not the remarkable supply of blood to the encephalon and to the spinal cord, be intended to furnish materials for the secretion between the pia mater and arachnoid membrane, from which secretion a considerable supply of nervous fluid may be obtained? Many important phenomena might be explained by taking this view of the subject.

Sec. 478. The author introduces into his subject much unnecessary confusion, by laying down the proposition that the *cerebrum is the sole instrument of INTELLIGENCE* and still more by confounding *intelligence*, which is the result of the action of the mental faculties generally, with the result of one of the functions, called Invention; by the exercise of which, means are adapted to ends. The subject is rendered still more unintelligible, by attempting to draw a distinction between intelligence and instinct, or between the intelligent adaptation of means to ends, which is in itself an instinctive act; and other instincts, such as the taking of food or the indulgence of the venereal appetite. The fact that infants sometimes suck without a cerebrum, only proves that this organ is not indispensable to the operation of the mind; but it can have no weight as an argument to prove that this act is not one of intelligence, or is not directed by the mind.

The fact that physicians occasionally consult the inclination or disinclination of the patient in applying remedies, serves to show that the mind should be regarded as having the direction of the operations taking place within the body, and as being capable of pointing out what would be proper and what improper. In other words, this fact should convince us of the immediate agency of the mind in all the operations of the body.

Sec. 479. The importance of the distinction we have drawn between the instincts or instinctive acts, that is, into determinate and general, is here clearly shown.

The author calls the first purely instinctive acts, and the general instincts he speaks of as "*those which rather result from the intellectual faculties, prompted by the instinctive propensities.*" The exercise of invention, or the adaptation of means to ends, is prompted by a general instinct, which the author thinks is stronger in birds than in in-



sects. Invention is a single function of the mind, but it does not require the co-operation of all the mental faculties, as the author implies. Invention is not, and should not be, regarded as synonymous with intelligence; for this function may be developed in animals of inferior intelligence, although it is commonly associated with the higher faculties, as it is in man.

Sec. 480. I object to the introduction into use of the term educability. The idea may be expressed by referring the phenomena to the development of invention.

Sec. 481. May not the power of an animal, I mean the sum of its actions, resulting from the use of the nervous fluid, be measured by the quantity of the secretion in the nervous centres, or by the capacity of these centres?

Sec. 483. The views set forth in this paragraph are confused and unsatisfactory. The Mind or Soul, which is the immaterial existence of living beings, is endowed with certain simple faculties, as Observation, Imagination, Memory, &c.; it is also endowed with certain affections or emotions, as Love, Fear, Anger, &c.; and it is further endowed with the capacity of combining the exercise of several of the simple faculties into one act, called a function, as that of Reason, Invention, &c. The Mind is moreover impressed with, or has stamped into it, the Instincts, which are the commands of its Creator, directing the performance of such acts as may be necessary to carry out his designs. The exercise of the simple faculties, of the affections, and of the functions of the Mind, are prompted by the Instincts which we have said belong to the Mind or Intellect; consequently, all these exercises or acts are acts of intelligence.

Sec. 484. The Mind makes use of the Cerebrum in causing the circulation of the nervous fluid for the execution of its various purposes, and the more various and important these purposes are, the more will particular parts or portions of this organ be developed, in consequence of the increased exercise of such parts or portions. This I think will account for the development, under certain circumstances, of the Brain as well as of its individual parts; this development being the *result*, and not the *cause*, of the operations of the Mind. What the author seems to understand by the term *genius*, is nothing more than a morbidly developed imagination—a development carried to excess, at the expense of other mental endowments.

Sec. 486. The fact that inflammation of the cortical substance, or

of the membranes, gives rise to general action, favors the supposition that the secretion in the centres is the measure of the power of an animal; for such inflammation would be attended with a preternatural flow of blood to the parts, and probably a preternaturally increased secretion, which the mind endeavors to get rid of by determining it to the several organs; the inflammation of the fibrous portion of the cerebrum would have a contrary effect, by withdrawing the fluid from the secreting membrane.

Sec. 487. What give rise to the operations of the Intellect are the Instincts, and these only; that is to say, that the exercise of the faculties, affections, and functions of the Mind, are prompted solely by the Instincts. External circumstances, such as stimuli, may furnish the condition or occasion which the Mind may judge proper for the exercise of these faculties, affections, or functions, or for the indulgence of the determinate Instincts; but they can have no other agency in relation to these acts. An animal may feel hungry without having his food before him, although the presence of his food might exercise an increased desire for food; and indeed the sensation of hunger might first be excited by the presence of the food, that is, by the life of the food acting on his nerves; still the sensation would have its origin in his Instincts, and not in the food before him. The sight of a female might furnish the condition or occasion which his mind might judge proper for the indulgence of his venereal desires; and the sight of the female might arouse these desires, that were not before awakened; yet the feeling or sensation that would prompt his action would have its origin in his own mind, and not in the female.

Sec. 489. The distinction drawn between Perception and Sensation appears to me to be erroneous. The author makes the difference between the two to consist in the degree of impulse of an impression, or in the afferent quantity of the fluid transmitted through the afferent nerves of the senses. I do not think, however, that there can be any proper distinction between the terms—the difference between sensations or impressions arising solely from the different attention given to them. In the case of the student's not hearing the striking of the clock, when his mind was otherwise engaged, the fact is readily explained by reference to the circumstance, that, by giving attention to any impression, the mind determines the nervous fluid to the neurilemma of the nerves receiving the impression, and thus renders them more permeable, or effects certain changes in the impressions that may

be necessary, before they reach the sensorium. When attention is not given to impressions, such determination of the nervous fluid does not take place, or, at all events, takes place imperfectly; consequently there would be a difference in the effect produced on the mind. In Perception, however, as well as in Sensation, attention may be paid to impressions. The more frequently attention is given to any nerve, or set of nerves, the more permeable do they become, and the more readily are impressions transmitted through them; and this readiness of transmission constitutes habit. Thus we may acquire the habit of exercising any set of muscles, simply by frequently transmitting the nervous fluid to and from them. In the same way we acquire a habit of exercising any of the senses, by frequently transmitting the nervous fluid through their peculiar nerves.

Sec. 490. The acquirement of Perceptions is not a *cerebral* but a *mental* operation. The emotions or affections are expressed by the Mind determining the nervous fluid to the muscles of the countenance generally, but sometimes to other muscles; a shrug of the shoulder is very expressive of emotion. These movements of the muscles are more readily interpreted than words, especially by young children.

Sec. 491. Memory is a faculty of the Mind, and has nothing to do with the cerebrum, further than that the cerebrum is the organ through the medium of which sensations are conveyed to the Mind; an injury of this organ may affect any of the faculties of the Mind, for they may become dormant from a want of due exercise.

Sec. 492. What is referred to Conception, is nothing more than an operation of the Imagination.

Sec. 493. What the author calls Internal Perception, Reflection or Introspection, Intellectual Ideas, and Trains of Thought, are merely instances of the exercise of Reason; and the belief in our present and past existence; in our personal identity; in the stability of the order of Nature, &c., are plainly the conclusions arrived at by this exercise of Reason. They are certainly not derived from any changes in the cerebrum.

Sec. 494. The author seems to have formed a very imperfect and erroneous notion concerning the process of reasoning. I have published what I believe to be a true and simple account of this process, which I have represented as consisting in the combined exercise of three of the simple mental faculties—Observation or Perception, Imagination, and Judgment. The author has confounded the exercise of the affections

or emotions with that of the Imagination, from the fact that the emotions are frequently exalted by means of the Imagination into what are called the Passions; and again, he has confounded the function of Reason, the result of which is the attainment of general conclusions, with the function of Invention, the result of which is the adaptation of means to ends. The author takes occasion, after a certain interval, to construct a sentence, *ad captandum*, which, as it winds up with something about purity and love, some of his readers will think very pretty. All that I can derive from it, however, is a very imperfectly expressed acknowledgment, that the Imagination is concerned in the process of reasoning.

Sec. 504. In all spasmodic diseases the nervous centres, and especially the spinal axis, is in a preternaturally active state, and the nervous fluid being consequently withdrawn from the muscles, they become rigid, contracted, or convulsed.

Sec. 514. The properties of bodies are nothing more than the subtile fluid, Life, which composes their substance, and which is continually passing from them and entering other bodies. The impression from this fluid is received through the nerves of living beings, and transmitted to the Mind. The various forms in which this fluid is given off, gives rise to the various impressions received, as of color, quantity, quality, &c.; which impressions again are suited to the several varieties in the nerves through which they have to pass, as those of sight, smell, hearing, touch, &c.

Sec. 515. The feelings of hunger, thirst, nausea, venereal appetite, &c., arise from the preternatural state of the nerves distributed to the organs concerned; this preternatural state of the nerves proceeds from the determination of the nervous fluid to them by the Mind; which fluid accumulates in the extremities of the efferent nerves, or causes the flow of blood to the part by dilating the vessels, either of which would place the nerves in an unnatural state, and give rise to a sense of uneasiness.

Sec. 521. The facts mentioned in this and the two preceding paragraphs, tend to show the correctness of the meaning we have attached to the term attention, or rather to the correctness of the view we have taken of the process that takes place in the exercise of attention, namely, that the act consists in the determination of the nervous fluid, by the Mind, to the neurilemma of the nerves concerned in conveying impressions to the Mind; thus causing their dilatation, and rendering them more permeable to such impressions.



Sec. 523. The nerves of touch, like those of the other senses, are made capable of receiving a peculiar form of the subtile fluid, Life, which is ever passing off from all material bodies.

Sec. 524. The feeling of tickling proceeds from the unusual impressions transmitted through the nerves; which excites the nervous centre, and induces the mind to make an effort to get rid of this excitement by calling into action the muscles of respiration, producing laughter.

Sec. 526. The facts here enumerated may be well explained by means of my hypothesis concerning the subtile fluid, Life; this fluid, transmitted through the water, was the means by which the whales became aware of the suffering of their fellow at a distance from them.

Sec. 527. The nerves supplying the organs of taste are adapted to receive the peculiar form of life given off by sapid bodies; but there is this peculiarity in them, that this form of life must undergo a change, by being subjected to the action of the saliva, before it can be transmitted through the nerves to the mind.

Sec. 529. The phenomena mentioned in this paragraph may be readily explained, by referring to our view of the operation of the nerves of the senses in connexion with what we have said in relation to attention, without confounding together the operations of the two distinct senses of taste and smell. Inflammation of the Schneiderian membrane, closing the nostrils, and all other means used to blunt this sense, act simply by withdrawing the attention of the mind from the nerves immediately engaged in the act of smelling; thus rendering them less permeable by the impressions made on them; and this view is confirmed by the fact afterwards mentioned, namely, that the sense can be improved, or the nerves rendered more sensible or more permeable, by frequently directing attention to them, as in the case of the experienced wine taster, or of the epicure.

Odours are merely forms of the subtile fluid, Life, which are constantly given off by all odorous bodies. Certain substances, as musk, may have the power of converting the life received from the atmosphere, or other surrounding bodies, into its peculiar form of life, or into its own substance, and be thus enabled to preserve the same weight for a long time.

Sec. 533. Light is a form of life derived principally from the Sun, but may be obtained from the decomposition of many substances, as in ignition and in putrefaction; it is also sometimes formed as a secre-

tion, as in the fire-fly, &c. It seems, however, that it must pass through certain changes, like odours and sapid bodies, before it can be transmitted through the nerves allotted to the sense of vision. This change it undergoes in passing through the coats and humors of the eye, at the same time that the direction of its currents or rays is modified by those bodies. The image which is reflected from the retina I do not think is essential to the performance of the function of Vision, but I believe it to be altogether accidental, or simply the result of the reflection of the light from a transparent membrane, as the retina, coated behind with the opaque corded coat. The fluid which constitutes light, I believe, is transmitted, undergoing certain changes as it passes along, through the optic nerves, and is all that is necessary to produce the requisite impressions on the mind. Glasses have the effect of concentrating or diffusing the light, and thus aid or diminish the force of its impression, and at the same time serve to fix the attention of the mind on the nerves employed.

Sec. 556. What we have said in regard to the other senses is applicable to the sense of Hearing. Sound is a form of life which becomes modified as it passes through the various parts of the ear, and through the auditory nerve, in order that it may make the due impression on the mind. Music may be regarded as that form, or those forms, of sound which may pass through these various passages without doing violence to the parts concerned in transmitting them, or rather which produce an agreeable excitement in such parts; whilst unmusical or harsh sounds have a contrary effect.

Finally, in the exercise of each and of all of the senses, the faculty of the Mind, called Judgment, must be improved by exercise before the full benefit can be derived from these sources of information; and the judgment must be guided by what we have called the Rule of Right implanted in every mind. The preservation of this *réglé* is what constitutes taste, as applied to the arts.

Sec. 573. I adopt, unhesitatingly, the opinion which the author argues against, and which he considers exploded, namely, that no movement nor change is effected in the living body, unless through the agency of the nervous system, operated on by the mind or soul. That contractility is any thing real, substantive, or even conceivable, as having an inherent connexion with the muscular fibre, I utterly deny. Contractility is nothing more than a term, that should express the idea that a muscle may be, or is capable of being, contracted, when its appropri-

ate cause of action is brought into operation. This cause of action, or rather of want of action, is the withdrawal from the fibres of the nervous fluid, and not, as is supposed, any active agent whatever, and certainly not any agency inherent in the muscle or fibre.

How Physiologists can positively and universally deny that plants have any thing in their economy analogous to the nervous system of animals, is to me one of the most remarkable circumstances in the history of the sciences; since the fact is so very palpable, that the Pith and Medullary processes are the analogues of the cerebral-spinal axis and the nerves, that it appears impossible to overlook the analogy. All the phenomena of the vegetable world tend to show that plants perform a great variety of acts in obedience to their instincts, strikingly resembling similar acts in animals, and dependent, undoubtedly, on the same mechanism in their structure. They select their appropriate food from the soil in which they grow; elaborate this food into their various organs; throw out tendrils, in some instances, and entwine them around objects suitable to their support; are sensible to variations in the weather, &c., &c.; all of which acts it is impossible to explain, or refer to any general law, without the supposition that they are possessed of a nervous system, or its analogue.

Sec. 574. The distinction between the conditions of muscle, of muscular fibre, called irritability and tonicity, is simply this, that in the former there is readiness in the nerves communicating with the muscle to transmit the nervous fluid to or from the centre, or through themselves when unconnected with a centre. Tonicity depends upon the muscle having a due supply of nervous fluid, that is, such a supply as will preserve it in a state of moderate contraction or tension. This state is dependent for the most part on the action of the nerves, and more particularly of the nervous centres, which, when moderately excited, preserve the just balance in the supply of the fluid.

Sec. 575. No muscular fibre belonging to a living being, or possessed of vital activity, can be caused to contract by stimuli, unless these stimuli act through the medium of the nervous system, and in a normal state of the economy, the agency of the nervous system is invariably under the control and subject to the prompting or direction of the mind. This general law is applicable to the non-striated as well as to the striated fibres. In the former, however, the stimuli are so constantly applied, and so continually followed by actions, that such actions commonly do not arrest the attention or arouse the consciousness of the

mind. I have already explained the action of the bladder, uterus, and heart. The relaxation of these organs is the active state, and the contraction of them the passive state.

Sec. 576. Stimuli applied to the nerves which supply any muscle, produce a contraction of the muscle by conveying the impression to the nervous centre, and causing action there, by which means the nervous fluid is withdrawn from the muscle. The contraction speedily alternates with relaxation, because the action cannot be maintained in the centre, but for a limited time in the normal state; although it may be continued by an electric current, or any other preternatural stimulus continuously applied.

The non-striated muscles require peculiar impressions to be made on their nerves, in order to their being brought into action; and the action of any part of a tube about which this form of muscle is placed, is dependent commonly upon the action in some other part. Thus, an impression made on the middle of the œsophagus might not be followed by any action, although that impression be made by pinching or pricking it; when an impression made at the same time with a morsel of food from the fauces, would produce the act of deglutition or action through the whole course of the tube.

The heart, when removed from the body, may be contracted either by the action of its nerves, which, by being dilated, withdraw the nervous fluid from the muscular fibres, or these fibres may be contracted simply by the loss of the nervous fluid from the cut extremities of the nerves.

Sec. 577. In the normal condition the centres and periphery of the nervous system in a living being are alternately in an active and inactive state. When the centres are in an active state, the muscles or fibres become contracted; when there is action at the periphery, or when there is a determination through this extremity of the nerves to the fibres, the latter become elongated or relaxed; and yet this relaxation is not a state of inaction as is commonly supposed, but it is the really and only active state of the fibres. The action of a stimulus continually operating on the centres or periphery may produce continued spasm or relaxation.

Sec. 579. Narcotics act directly on the nervous system, impairing its powers, as the medium through which the mind directs the circulation of the nervous fluid; but the fact that the muscles may be made to contract after the nerves have been deadened, or their powers impaired



by the use of narcotics, furnishes no proof whatever that the irritability of muscles is independent of the agency of the nerves. The fluid in the nerves might still be liable to be operated on by the electric current, or other artificial means, and thus give rise to, or cause the contraction of, the muscles.

Sec. 580. The effects resulting from concussion arise from the sudden preternatural action of the centres, by which means the nervous fluid is withdrawn from some organ whose action cannot be suspended even for a short time without endangering life. I witnessed a case wherein a woman was struck on the stomach by her husband, both of them being partially intoxicated, and having their feelings highly wrought. The woman fell down senseless, and the action of the heart and arteries was entirely suspended; but the abdomen soon became distended, and the stomach and intestines enormously dilated or expanded. It seemed to me that the nervous fluid had been withdrawn from the system generally, and then preternaturally determined to the stomach and intestines at the expense of the heart and blood vessels.

Sec. 583. The fact that the energy of muscular contraction is determined by the supply of arterial blood which the muscle receives, may be explained without supposing that the blood has any agency in increasing the irritability of the muscle. It is a general law of nature that there must be a continual interchange of the subtile fluid, which is the basis of matter among all the objects of the material world. No material object can be so independent of other surrounding objects as not to be constrained to give off life in some form to, and receive life from, them. If any form of matter gives off more life than it receives, it must cease to exist in that form; and if any form receives more life than it gives off, there must be a change in it—it must grow. This law applies to living as well as to dead matter; and it applies, too, to the individual organs or parts of such objects. Thus, in the exercise of the senses we have said there is a determination of the nervous fluid (which is the life of an animal) to the nerves of the senses, at the same time that impression (that is, the life from external objects) are received from them. So, in the exercise of the muscles, life must be received from some source, else its supply would soon be exhausted, and this source is the blood, the increased supply of which, when a muscle is in action, is owing to the dilatation of the blood vessels resulting from the determination to them of an increased supply of nervous fluid. This explanation becomes more important when applied to the phenomena observed

in the action of the organs possessed of what are called erectile tissues. The extraordinary supply of blood observed in such cases is intended to subserve the purpose here indicated, and has no agency, except incidental, in causing the distension of the organ. The principal agent in such instances, as in the erection of the penis, is the nervous fluid, which is determined to the fibres of the organ, and causes their active elongation or extension.

Sec. 586. The doctrine, now generally accepted as a physiological truth, that the active exercise of the contractility of muscle is attended with a waste or disintegration of its tissue, is unfounded and altogether gratuitous.

1st. The increase in the demand for food occasioned by muscular activity, is an indication that the life of the animal, its nervous fluid, has been exhausted by this means, and that the animal requires a further supply, which he finds it necessary to obtain by taking food.

2d. Oxygen can not be essential to the contractile force of a muscle, because this force is solely dependent upon the action of its corresponding nerves or nervous centres.

3d. Experiments made to prove that there is a chemical change in muscles, when exercised, are entitled to no consideration, because it is a subject foreign from chemistry, and one in which the chemist is unable to take cognizance of the principal agent in bringing about changes, that is, the nervous fluid; and further, it would be utterly impossible by the most careful analysis to arrive at any appreciable difference resulting from the action of a muscle.

4th. The increase in the excretions show nothing; for they may be increased by any cause that determines a flow of the nervous fluid and of the blood to the excretory organs. The augmentation of the carbonic acid from the lungs, and of urea from the kidneys, may proceed from many other causes than the disintegration of the muscles. Simply a change in diet is sufficient to effect such augmentation. If the author were satisfied with admitting, that the change in the condition of a muscle effected by exercise is merely incidental, as he seems to intimate in the next paragraph, I agree with him; but I do not admit that such change is essential to the action of a muscle. It is certainly true, that frequently renewed exercise of muscles occasions an increase in their nutrition; but it has not been shown that in every act of a muscle there is a loss of its substance; and even if this were true, it would not follow that the action of the muscle was dependent on this

change in its condition or substance ; particularly when we can refer this action to a much more simple cause.

Sec. 588. In the frequent exercise of any muscle or muscles, the nerves connecting them with the centres acquire a readiness in transmitting their fluids; they become as it were more permeable ; and, on the contrary, this readiness in transmitting impressions on their fluids, or this permeability, is partially lost by disuse. This disuse of the nerves of any organ or part, if unusual, will of course be attended with the cessation of the usual nutritive processes. These are facts of common observation, and they go to show that the nutritive processes are clearly dependent upon nervous agency ; but they cannot be made to show that there is any necessary connexion between the nutrition and action of a muscle. These two processes are distinct, although they frequently accompany each other. They both depend on nervous agency, but the nerves engaged in one of them belong to a different class of nerves from those engaged in the other process. The nerves destined for muscular action transmit a fluid which elongates or extends the fibre ; the nerves of nutrition convey a fluid which combines with the circulating fluids, and converts them into the solids.

Sec. 589. I totally deny that there is any thing substantive to be understood by the term Muscular Irritability. The objections advanced against the doctrine, that muscular action as well as all other vital actions are dependent upon the immediate agency of the nervous fluid, are futile in the extreme. The first, namely, the improbability that one tissue should give a property to another tissue, is unworthy of any serious notice from us, inasmuch as we do not admit the existence of any such property, or require its agency in explaining the phenomena of muscular action. The second objection, namely, that vegetable tissues are capable of contraction, or, as he expresses it, are endowed with contractility in a high degree, has no weight whatever with me ; for I admit that plants possess the same mechanism as animals ; that they have a nervous system in their pith and medullary processes ; and, further, that they are possessed of an immaterial existence on which their instincts are impressed, separate and distinct from their material bodies. The same may be said of the lower classes of animals, their actions all depend on nervous agency. Neither is the third objection entitled to regard, that is, that the action of the heart may be kept up by taking care that the current of the circulation be not interrupted ; for it is certain that, if the circulation is not interrupted, there will be sufficient

communication with the nerves and centres to maintain the action of the heart. Where there are neither brain nor spinal cord, there must be some other centres to supply their place.

I embrace the broad doctrine that all actions in the living body require the agency of the nervous system, and are solely dependent on this agency, without any modification. The experiment of Dr. Reid, to my mind, proves nothing; for the limbs of the frogs which he considered cut off from all nervous connexion, were evidently in connexion with other nervous centres through the medium of their nerves, although they may have been separated from the spinal cord directly, by the scission of the spinal nerves. The notion that muscular contractility is something substantive, leads the author into vast confusion of thought. The experiment of Dr. Reid alluded to in Note C, proves conclusively that nervous influence is essential to the nutritive process; but it is here adduced to prove that the loss of irritability which follows the severance of the connexion between the nervous centres and the muscle, is not immediately due to the interruption of any influence communicated by the former. The experiment of dividing the sciatic nerve of the rabbit is of the same character as the one already alluded to, and proves nothing more.

Sec. 590. The false or erroneous notion in regard to muscular contractility or irritability, has led the author to reject the hypothesis that all stimuli, which excite muscles to contraction, operate first on the nervous filaments which enter muscles, and through them on the muscular fibres. The observation of Mr. Bowman, on which the author relies as the main support of his peculiar views, simply shows that an isolated fibre may have the fluid from its nerve withdrawn or destroyed by irritation, or by chemical stimuli.

Sec. 593. If I understand the author's meaning, which I am not certain of, the state of the muscle to which the term Tonicity should be applied, is that superinduced by the moderate action of its afferent nerves and of its corresponding nervous centre; by which means rather less of the nervous fluid is retained in its fibres than is sufficient for their full and free extension; they are, in this state, verging on a state of contraction. The rigor mortis is a condition of the muscles very different from this; for, in the latter state, the nervous centres as well as the nerves have lost their action, and the nervous fluid is left to be distributed according to its natural tendency, which is, to be withdrawn from the flexors, and to flow towards the extensors; hence the flexors



are contracted and the extensors rigidly extended. This view of the subject will, I think, explain all the facts observed, or that are mentioned in the text.

The account of the voice and speech may, I think, be simplified so as to be expressed in few words. Sound is a form of life, and the voice of animals are but modifications of their peculiar life, or their nervous fluid. The vocal sounds are produced by determining the nervous fluid to the vocal tube, embracing the trachea, larynx, and the outlets through the mouth and nostrils. Tones or notes result from the greater determination of this fluid to particular parts of the vocal tube; in the lower notes to the lower portions, and in the higher notes to the upper portions, of the tube. The vocal sounds, modified by the life given off by the several parts of the mouth, as the fauces, palate, teeth, lips, and tongue, are formed into articulate sounds. The muscular fibres about the larynx and trachea are no doubt intended to assist in modifying the voice, but they do this probably by fixing the tube and varying its calibre or the volume of air contained in it; but I believe the principal object attained by the muscles about the larynx is the closure of the rima glottidis, in order to exclude deleterious substances from the lungs. The active state of these muscles, it must be recollected, being that of extension of their fibres, would produce effects opposite to those attributed to them in the text. The oscillations or vibrations of the tube formed by the trachea and larynx, or of parts of this tube, may be essential to the formation of tones; but such vibrations could not take place unless the tube was made tense by the action of muscles.

Sec. 619. The view taken above, of the formation of the voice and speech, enables us to suggest a plain and simple explanation of stammering, which is caused simply by a want of readiness in transmitting the nervous fluid by the nerves going to the organs, or some of the organs, engaged in forming articulate sounds. An impediment in, or the deranged function of, these nerves would account for all the phenomena. The greater difficulty experienced from anxiety to speak fluently arises from the fact that, under such circumstances, there is a preternatural activity of the nervous centres, which tends to concentrate the fluid there, and consequently prevents its determination through the proper nerves. The remedial means are, as suggested in the text, to restore this readiness in the nerves, by judicious exercise of the nerves implicated; thus improving the judgment, and imparting confidence to the mind of the sufferer.

Sec. 620. The great difficulty with the author and his sect, in acknowledging the important and palpable truth that all vital changes, actions, and movements depend on the immediate agency of the Nervous system, seems to arise from the fact that Plants are capable of certain changes and movements similar to those observed in Animals; and, assuming as a truth that which is a gross and palpable error, namely, that Plants have nothing approaching to a Nervous system, they insist upon it, that such changes and movements in Animals must be referred to some other agency; and yet they admit that the processes alluded to are influenced by the action of Nerves.

The next error which misleads them from taking a correct view of the subject, is the assumption that muscular action consists in contraction, when it really consists in extension or elongation. Thus, the first step in nutritive absorption (which altogether escapes their observation) is the dilatation of the cells or tubes through which the fluid has to pass. This dilatation, effected by the active elongation of the fibres about the cells or tubes, is brought about by the immediate agency of the nervous fluid transmitted to them; the contraction, which is regarded as the first, being in reality the second stage in the process, and merely the reaction from the active state of the organs referred to.

Another difficulty experienced in arriving at the truth, in regard to this subject, arises from a want of such an acquaintance with the economy of Nature as leads to the acknowledgment that the basis of all matter is a subtile fluid, by the agency of which alone, the different forms of matter are both constituted and dissolved. Thus it might be seen, that an organized tissue, or a secretion, may be formed simply by the union of the nervous fluid, which is the life of an animal, with the circulating fluid; although it must be borne in mind that such union can only take place in accordance with certain fixed laws, established by the Author of Nature for the governance of the changes that take place in the living economy. The active state of the heart does not produce *impulsion*, as we have before shown; neither does the active state of the muscles of respiration, or of any fibres about the walls of any of the tubes or hollow organs. The relaxed state of the uterus referred to is its active state, caused by a preternatural determination to its fibres of the nervous fluid, which is their cause of action; and the application of suction, or other irritation to the nipple, by making a revulsion from the uterus, or diverting its cause of action from it, causes its contraction.

Sec. 621. That the visceral nerves are endowed with a high degree of sensibility, or are highly sensitive, is a matter of common experience. The reason why the matter in contact with these extremities does not cause sensation is, that it is brought into relation with the nerves in passing through the previous stages in its progress, as the contents of the alimentary canal, or of the excretory ducts of other viscera.

Sec. 622. There is a mode of connexion between distant points in the living system which seems to have been overlooked by physiologists. I allude to the chain of what I have understood by the reflex actions. Thus, a full meal taken into the stomach originates an action, which is propagated along the absorbents, lacteals, and blood vessels, to the remotest part of the system; and this action may become inordinate in the direction of some one point, or some one of the viscera, producing there increased action in the tubes, or increased sensation, or both; and this inordinate action is most apt to be determined to the point or organ wherein the nerves have been most exercised; hence an action, originating in a full meal, or any other cause, may become inordinate when determined to the lungs, the heart, the liver, the genital organs, or even to any point—as a wound, where the nerves have been exercised more than usual, arising from any cause. By this means a connexion is established between actions in distant points of the system that could not be referred to the agency of any nerve or set of nerves.

Sec. 623. By emotional conditions of the Mind, the author seems to mean the Passions, which are, as we have said, the Affections exalted by the Imagination. The first effect of passion on the system is the withdrawal of the nervous fluid from the periphery of the nerves, and its collection or concentration upon the centres. This I conceive to be an instinctive act of the Mind, in order that it may have at its disposal a larger supply of the fluid, to be determined when occasion might require; hence we see pallor of the surface and contractions of the muscles, especially those of the face. This first stage is followed, however, sooner or later, by a reaction, wherein the Mind determines the fluid in an excessive manner to some of the viscera or organs, or to the blood vessels of the face and neck, causing, in some instances, blushing; in others, a redness of the face more permanent than blushing. All the phenomena presented in the exercise of the Passions, may be readily referred to these conditions of the Nervous system, brought about by the immediate agency of the Mind.

Sec. 624. "There is good evidence," not only "that the Nervous

system has an immediate action upon the molecular changes, which constitute the functions of Nutrition and Secretion," &c.; but it is clear to my mind, that, without the agency of the Nervous system, these functions could not be performed at all; and it is also clear, that these molecular changes are solely attributable to the agency of the nervous fluid. It is impossible that any one could prove what the earliest condition of fœtal life consists in; or that, in this condition, there is no germ of the Nervous system. From analogy we may conclude that, as soon as the embryo commences an independent action, that is, an action resulting in the formation of any part or organ of its body, that it is possessed of a Nervous system, however imperfect. And here I will take occasion to repeat, that I believe that the actions in the first stages of embryonic life, as well as in all subsequent stages of development, are effected or guided by the Mind, or the immaterial existence of the individual, prompted and instructed by the Instincts, which are the commands impressed upon it by its Creator. I again repeat my conviction, that the Nervous system is the only medium through which the Mind, or the immaterial existence, is brought into relation with the material world, so as to be enabled to effect changes in it, or be affected by impressions from it. With this view, there is no occasion to admit the existence of any inherent properties of the tissues, for all the phenomena of existence may be explained more satisfactorily without the use of such properties. Secretion may take place after death; that is, after the Mind has lost its control over the body, because the nervous fluid contained in the nerves and nervous centres may flow to the periphery of the nerves, and there, combining with the fluids, form secretions, or the substance of the tissues; but, in most instances of these formations, death is only apparent; the vital actions being suspended only in some parts of the system, whilst there is sufficient vitality to carry on the processes in other parts.

Sec. 625. The influence of the Nervous system upon the secretions is simply this, that it is the medium or channel through which the nervous fluid is conveyed to the secretory organ; which fluid, combining with the fluids circulating in its vessels, constitute the secretions themselves. Whenever the flow of the nervous fluid is interrupted, the secretion is suspended; and whenever there is an increased determination of the fluid to a secretory organ, there is an increased formation of the secretions. Here, again, we have an easy explanation of the phenomena, presented in modifications or alterations of the secre-



tions, brought about by affections of the Mind. If the affection be favorable to a determination of the nervous fluid *from* the centres, there is excitement in one or more secretions; if the mental affections are favorable, or tend to determine the nervous fluid *to* the centres, the secretions become more or less affected; some one or more of them being suspended wholly or partially. Hence we may clearly understand how the indulgence of a fretful temper in a nursing female may, by interrupting the normal flow of the nervous fluid, suspend the secretion of milk, or change its nature, so that it will produce marked effects on the alimentary canal of the infant; altering the appearance of the stools, and vitiating, more or less, the secretions that contribute to the digestive process. The same may be said of the other secretions which are observed to be influenced by affections of the Mind. Freedom from anxiety and despair, are attended with the same condition of the nerves, for, in both conditions, there is no extraordinary action of the centres, so that the nervous fluid is allowed to flow to the periphery, and consequently the secretion of fat is increased. The love of the sexes is an affection which, if properly indulged, is attended with infinite pleasure; but if it is exalted into a passion by an inordinate excitement of the Imagination, creating a train of lascivious thoughts and ideas, it commonly produces the most direful effects on the Mind, weakening all its powers, and rendering it miserable and wretched.

In reflecting on the above observation, with a number of others that might be made of a kindred nature, we may, by the exercise of Reason, arrive at the all-important conclusion, that the happiness of living beings has its foundation in a due or proper indulgence of the Instinctive desires; that is to say, an indulgence conformable to the will of Him who is the Supreme Governor of the universe; and, on the contrary, that unhappiness or misery is the result of a disregard or an improper indulgence of the same desires.

Sec. 629. The following long account of food, and of the Digestive process, is given, according to the German system of Philosophy, without the slightest reference to the Mind or to a Creator. The whole of the phenomena are attempted to be explained without the aid of the one or the other. Instead of following the author through his long and complex account, wherein he arrives at no practical conclusions, I will briefly state my understanding of this subject. What seems to be an important object in the scheme of Creation is, that there should be a constant interchange of the subtile fluid called Life, which, by its

combinations, constitutes every form of matter among the several forms of which the material world is composed. To attain this object, laws were established for the government of inorganic or lifeless bodies, by virtue of which these interchanges were made to take place under particular circumstances. To these laws are to be referred the movements as well of the heavenly bodies as of terrestrial bodies, together with the various interchanges that take place among them. The law of Gravitation, as well as the laws of Chemical Changes—of Attraction, and of Repulsion—may all be resolved into, or traced up to, this great object in the economy of Nature. The law of Gravitation which, as proposed by Sir Isaac Newton, is but a generalization of the human Mind, or an hypothesis formed by a human Imagination, becomes, in connexion with this view of the subject, a law of Nature; the apple that falls from the tree is drawn to the earth, that it may impart its life to, or interchange its life with, the earth, until its life is dissipated and it ceases to exist, as happens with all perishable bodies. The stone, when thrown in the air, falls to the earth for the same cause; but as it interchanges life more slowly, or receives as much life as it gives off, its form continues. The same thing takes place in chemical attraction. The pith ball is attracted towards a rod in a certain electrical condition, for the purpose of interchanging its life with it; and, when this has been carried to a certain extent, it is drawn off again in another direction, to interchange its life with the atmosphere, or other objects with which it may be surrounded. The alkalis interchange life with the acids, and a new material is formed, &c., &c. All these interchanges take place in accordance with certain fixed regulations established by the Author of Nature, which require that all bodies thus interchanging life should be in a certain relative condition towards each other; and it is the office of the Chemist, and of the Natural Philosopher, to discover the nature of these relative conditions, or what they consist in, in order that changes of form may be effected.

To carry out this great object seems to have been a leading motive in the creation of living beings; for this purpose the Author of Nature has impressed on the minds, or immaterial existence of such beings, instincts or commands, the aim of which seems to be the accomplishment of this object. In the primitive ages of our globe plants were created, that they might interchange life with the soil on which they grew. Subsequently animals were created, to interchange life with the plants; and it is remarkable to observe, in considering the history of the

ages, when they were first created, how admirably they seem to have been adapted to such a purpose. Their size and structure suited precisely such an object. Again, as ages rolled on, animals were formed to prey on, and thus to interchange life with, beings of their own nature, at the same time that they were commanded to interchange life with each other in various other forms. As of sounds by means of the voice, of the affections by the means of the secretions, &c. This object seems to have been continually kept in view in creating the whole series of living beings. They were commanded to interchange life; and to enforce obedience to this command or instinct, they were so constituted that, if the instinct is not obeyed, they were made to experience a sensation of uneasiness or unhappiness; thus we have the true origin of the sensation called hunger. It is a sensation which living beings are made to feel as the natural consequence of a disregard of that precept of their Creator, which commands them to take food at stated intervals, or to make this kind of interchange of life, which he has appointed that they should make. This law of nature, by means of the operation of which the great object mentioned above is attained, is the chain which binds together every part of the universe.

Sec. 630. The evolution of the animal fabric, in every stage of its existence, is effected by the immaterial part of the animal guided by its instincts. "The materials which are subservient to this evolution are all derived from the external world, either immediately or through the medium of the parent." But these materials in passing to their destination, in the formation of the living tissues, are first resolved into the simple element which we have called life, before they are converted into these tissues; so that life, derived from any source whatever, may be converted into the animal solids, this form not being so material as the circumstance that it be derived from a sufficiently extensive range of objects; for it appears to be the will of the Creator that this interchange should not be confined to one or two objects, but that it should be extended to a certain number. In selecting articles of diet, the mind seems instinctively to make choice of such as not only may contribute to the formation of the tissues, but also of such as are calculated to cause a determination of a larger supply than usual of the nervous fluid to the digestive organs; of this nature are the condiments, as salt, &c., which in this way seem to favor the changes in the materials going on in the nutritive process. Thirst is merely a variety of hunger, originating in a like cause.

The theory which refers the heat of living beings to combustion, appears to me to be unphilosophical and unfounded. Animal heat is a secretion formed, like all other secretions, by the agency of the nervous fluid; and to maintain the body by this secretion at a proper temperature, a certain quantity of nutriment is required; but to attempt to regulate the nutriment, with the view to obtain the materials of combustion, seems ridiculous.

Sec. 655. In plants there is a process strikingly analogous to digestion. The fluid taken up by the spongioles or extremities of the roots passes through a series of cellular sacs, in which it becomes more and more elaborated as it passes along; being acted upon, no doubt, by a fluid analogous to the nervous fluid, which is conveyed to the sap through the medium of the medullary processes. The sap undergoes a change in the leaves analogous to the change effected in the blood by the lungs, and then, passing along through the tubes of the plant, it is still acted on by the same cause, until it is finally converted into the solids or tissues. The spongioles, then, are to the plant what the *primæ viæ*, or alimentary canal, is to the animal.

The process of taking alimentary matter into the system is attended with one principal purpose on the part of the Mind, and that is, the intimate commixture with it of the nervous fluid in various forms. This purpose or object is effected in the first place by mastication, by which means the food is not only comminuted or minutely divided, but at the same time, the nervous fluid, transmitted through the nerves and substance of the teeth, is intimately blended with the masticated food. The nervous fluid combined with, or entering into the composition of, the saliva, is by this means also mixed in, and the morsel thus prepared is fitted to excite the series of actions which take place in deglutition.

This series of actions or acts is divided into separate stages, in each of which the action or active state is confined to a small portion of the tube through which the aliment passes, as is well described in the text; but it should be particularly borne in mind that the active state consists in the dilatation of the part immediately preceding the morsel, and not in the contraction of the part through which it passes, the latter act being passive; and it should be further observed that, in all probability, the morsel undergoes some change from nervous agency in each stage through which it passes—as the sap in each of the sacs—that may fit it for exciting action in the subsequent stage. In this way the morsel



of food is conducted from the mouth to the stomach. In the latter organ there is constantly covering its internal surface a mucous secretion, the main purpose of which is, I suppose, in common with most other secretions, the supplying the nervous system with nervous fluid; although it may have some agency, like that of the saliva, in changing the condition of the alimentary mass in the stomach. The principal agent, however, in effecting these changes in this viscus, is the gastric juice, which is highly charged with the nervous fluid. The movements of the stomach by means of its muscular fibres are evidently intended to promote the changes alluded to, by bringing the contents of this viscus into an intimate union with the gastric juice. The changes produced in the contents of the stomach, by the causes referred to, prepare them as the appropriate stimulus which, acting on the sentient nerves of the pyloric orifice, causes the reflex action of its fibres which dilate the orifice; and thus the chyme, or so much of the food as has undergone a proper change, is allowed to pass into the duodenum. The phenomena observed by Dr. Beaumont are readily explained in the view I have proposed of the digestive process—the condition of the stomach itself and of its contents being clearly referable to the varying condition of the Nervous system.

Sec. 660. The process which takes place in the passage of the chyme through the intestinal canal is strictly analogous to that which occurs in the stomach. Changes are effected in it by the agency of the nervous fluid, in the form of the secretions of the mucous membrane, and of the auxiliary organs of digestion, the liver, pancreas, &c.; and the mass is prepared to pass, in part into the lacteals and other absorbent vessels, part along the course of the canal, until a residue is expelled as *fæces*. In the course of its passage a gate is fixed like the pyloric orifice of the stomach, where the mass is challenged, as it were, and required to produce evidence of its fitness to pass. This gate is at the commencement of the colon, and is called the valve of the colon; through which the contents of the ilium are hardly allowed to pass, unless previously prepared by the agency of the nervous fluid.

From what has been said it will be readily understood how the process of Digestion may be influenced by the affections of the Mind when unduly exalted. In this condition the nervous fluid is withdrawn, as we have heretofore stated, from the periphery of the nerves, and concentrated upon the centres. The secretions, which are formed by means of this fluid, become changed in their nature, or either re-

duced in quantity or entirely suspended; and consequently the whole process of which we are speaking becomes more or less disarranged.

Sec. 663. The long, complicated, unsatisfactory, and in some parts contradictory, account here given of chymification and chyfication may be advantageously substituted by the simple explanation we have suggested, namely, that they are the result of the changes effected in the alimentary mass by the agency of the nervous fluid, which is mixed with it in the form of the secretions that are poured into the alimentary canal, and intermingled with this mass as it passes along the *prima via*.

Why it should be necessary that this fluid should be modified as it is in these various secretions before the final result can be effected, is sufficiently answered by saying, that we find by observation that such is the appointment of the Author of Nature, and that it is our province not to inquire why, but simply to observe that it is so. The seasons are appointed to follow each other in regular order, and one season is made to be dependent on the one preceding it. So it is with the several stages in the growth of a plant, &c. Why these things are so ordered is certainly not a proper concern of ours.

Sec. 672. The readiness and simplicity with which the phenomena which are the proper objects of physiological science are explained by our views, furnish the strongest evidence of their correctness. The chyle is taken up from the intestinal canal by cellular sacs, similar to those before noticed in the spongioles of plants, and, being properly prepared by the agency of the nerves in these sacs, it is taken up by the lacteals, passing through which it undergoes, by the same agency, still further changes, which prepare it for its mixture with the blood. This agency of the nerves here, as in the other stages of the nutritive process, is not only the determination to, and intermingling of, the nervous fluid with the circulating mass, but probably at the same time a portion of a subtile fluid is received by the nerves to contribute to the general supply of nervous fluid. The same absorption of nervous fluid takes place from the blood distributed in the numerous blood-vessels observed in the villous processes. This supply of nervous fluid balances in some measure the expenditure necessary to effect the changes mentioned above; but the main supply of the nervous fluid for the general purposes of the economy is, as before stated, derived from the secretions. The correctness of this conclusion may be seen by considering the fact that when any of the more important secretions are interrupted or suspended, the vital actions seem

to suffer or to be imperfectly performed; and there is a sense of general lassitude and weakness, evidently dependent on a want of a due supply, in the system, of the nervous fluid. This supply of nervous fluid from the secretions is not only derived from them when passing through the excretory ducts, where there are such, but it is derived from them in the receptacles where they are stored up; as in the urinary and gall bladders, *vesiculæ seminales*, colon, &c.; and still further from the lymphatics, whose appropriate office in a normal state, I conceive to be, the absorption of the secretions that they may be the more effectually subjected to the absorbing action of the nerves. This function of the lymphatics seems necessary to counteract that of the lacteals. In the latter more nervous fluid is expended than is received, and this loss is counterbalanced by the fluid absorbed from the lymphatics. This view of the purpose answered by the lymphatics is supported by the fact that the origin or extremities of these vessels are most numerous, or perhaps are confined to the surfaces where the secretions are deposited, as the skin, &c.

Sec. 677. I do not deny that the lymphatics may, under certain circumstances, be induced to absorb other liquids, such for instance as are highly vitalized, but in a normal state I believe their office is to absorb only the secretions. The facts mentioned in this and subsequent paragraphs admit of a different explanation, if we may suppose that the lungs, as well as the general surface, absorb the basis of matter, as a subtile fluid, from the atmosphere; which, becoming variously combined, is finally converted into solid matter. This view of the office of the lymphatics leads to a hint that may serve to throw some light on the pathology of dropsy. In this disease the preternatural accumulation of the fluid, which is a secretion, may be owing to some change in its nature, from whatever cause, that may unfit it for the absorption by the lymphatics, which takes place in a normal state of the system. The secretions being highly vitalized fluids, the portion that is poured into the blood, after having passed through the lymphatics, may be still regarded as nutritious and not excrementitious.

Sec. 682. The account given of the elaboration of the nutritive materials is very good as far as it goes; but the author has omitted two of the most important considerations connected with this subject; these are, first, that the changes effected in the chyle as it passes through the lacteals, are the result of the agency of the nervous fluid; and second, that the office of the lymphatic system is to expose or subject elaborated

materials, as the secretions of glands, to the action of afferent nerves, in order that a supply of the nervous fluid may be obtained for the general purposes of the economy. With the assistance of the general laws now stated, the whole account of this subject is rendered plain and simple, and entirely satisfactory. The glandulæ of the lacteals, wherein their canal is convoluted, and thus greatly elongated or extended, cause the contents to be so much the more elaborated the more they are subjected to the action of the nerves; and the glandulæ of the lymphatics in the same manner render more complete the derivation of the nervous fluid from this source.

The anatomical structure and the functions of what are called the vascular glands, furnish a strong support, if not a positive proof, of our physiological views.

The principal supply of nervous fluid, or the principal sources whence this fluid is derived, is, we have said, from the lungs and from the secretions. Now the vascular glands are so anatomically arranged that a supply of nervous fluid may be derived from their lymphatics, which take up the fluid elaborated in them (and which may properly be regarded as a secretion,) whenever, from any cause, the supply is cut off from these principal sources. In foetal life, the functions of the brain, lungs, liver, and kidneys being dormant or suspended, the vascular glands corresponding to these organs, and whose functions may be regarded as substituted for them, are found to be remarkably developed. The brain being inactive, the fluids secreted on its surface are probably defective, and this defect is supplied by the action of the enlarged thyroid gland. The deficiency of supply from the lungs is made up by the action of the thymus gland, that of the liver by the spleen, and of the kidneys by the venal capsules. Inasmuch as a large supply of nervous fluid is required in the early stages of extra uterine life, and as the functions of the proper organs are then but imperfectly performed, the extraordinary development of these glands are continued to a period when their assistance can be dispensed with. They may be, however, and often are, called into action at any period of life when the emergencies of the economy require it. The other office attributed to these glands, that of being diverticula from the organs with which they are severally connected, I freely admit.

Sec. 691. The account of the "composition and properties of the chyle and lymph" is in entire accordance with our views. The changes represented in these fluids in their passage through their canals



are just such as we have said result from the agency of the Nervous system; the chyle becoming more elaborated, or deriving more vitality, and the lymph losing a portion of that which it originally possessed as these fluids proceed in their course. The change in the appearance of the lymph from a transparent fluid to one resembling the blood, is not due to its greater elaboration, but to a cause of an opposite nature; it is due to a loss of its vitality. The lymph was originally a secretion formed by the union of the nervous fluid with the blood, and the return of the nervous fluid into the nerves, which we have said occurs in the lymphatics, leaves the lymph in the condition represented in the text—a condition very similar to that of the blood out of which it was originally formed.

Sec. 696. The analysis of the blood, or the minute inquiry into its constituent portions, has been and can be attended with no practical good result. It is an infinite toil that has been rewarded with no fruit; and from the very nature of the subject, no benefit can reasonably be expected from such investigations. The results that have been arrived at by experimenters have been various, or have differed from each other, and, indeed, often contradictory. The same attention paid to the changes effected in the blood by the agency of the Nervous system might have led to the establishment of principles or general conclusions of the greatest importance, in explaining the functions of living Beings, and in remedying the derangements of them.

Sec. 698. The changes in the blood, or in the fluids which are destined to be converted into blood, we have attributed to nervous agency. The first of these changes results in the formation of albumen; another change produces fibrine from the albumen; and still another change transforms the fibrine into the solid tissues of the organism. In the same way the saline and fatty matters of the blood are the effects of nervous agency. The latter changes, which take place in the more fluid portion of the blood, seem to be preparatory to the conversion of this portion into the secretions, whence is derived the nervous fluid for the supply of the demands of the system at large. From this supply, heat is formed by means of the nervous fluid; hence we can understand how animal heat, which is a secretion, as light is a secretion from some animals, may be accounted for, without the absurd supposition of a combustion, which in the living system has no existence. The red corpuscles are the result of one of these changes, which may only take place after the change effected in the blood by the act of respiration; and their stimulating action upon the nervous and mus-

cular tissues is probably owing to the circumstance that they readily give off the nervous fluid which enters into their composition.

Sec. 699. The coagulation of the blood appears to me to be dependent on two material circumstances ; the first is, that the fibrine must lose the portion of life which rendered it fluid in the vessels when circulating ; and the other is, that it must derive a portion of life in some form from surrounding objects, but which is commonly derived from the atmosphere. If the rendering of its life is delayed or protracted by any cause, as in a surcharge by a stroke of lightning ; by being retained in the blood vessels where it derives more or less life for some time after death ; or by freezing or a low temperature, which impedes the passage of its life, or the nervous fluid ; or if this process is delayed by any other cause, the act of coagulation is postponed ; and, on the contrary, it is hastened by any cause that favors the loss of this life of the fibrine, as, for instance, the free exposure to an atmosphere of a moderate temperature, or a temperature favorable to the reception of the life from the fibrine. This temperature of the atmosphere happens to be the one most favorable to the imparting life to the fibrine, which we have said contributes towards the process of coagulation.

Sec. 700. The conversion of blood, when poured out on a living surface, or when confined in a living vessel, into organized tissue, is a process altogether distinct from that of coagulation. In this change, the nervous fluid, acting on the blood in the same way as if it were circulating in the vessels, converts the fibrine into the solid tissues.

Sec. 705. That the investigations made into this subject have been altogether barren, is shown by the fact mentioned here, namely, that the most important inference drawn from these investigations, that in relation to the Briffy coat, is calculated to lead to fatal errors in practice ; as the appearance may arise in opposite states of the system, requiring opposite modes of treatment.

Sec. 698. (o.) The experiments made by Puisseville are entitled to no regard, as they were conducted with no originality of thought, and without the exercise of reason. He saw nothing in his experiments but just what he wished to see, or what he had been taught to look for. They, of course, had not, nor were they intended to have, any other effect than the confirmation of errors which had long existed in Physiology. Neither were the experiments of Majendie attended with any more favorable result for the advancement of true knowledge. The cruelty exercised in these experiments seems to have been visited by the curse of barrenness.

The impediment which Poisseville observed in the circulation of the fluids through the capillary tubes, was no doubt owing to their want of proper elaboration or admixture with the nervous fluid, as the viscosity, which he observed to favor the circulation, was merely the result of such an elaboration as would fit them to pass along their course.

Sec. 706. If any proof be required to show the superiority of the method I propose in investigating Physiological subjects, and to show the greater importance of the conclusions which I have arrived at over the method pursued, and the conclusions drawn by others, it may be found in the fact that all the phenomena presented in the changes of the blood, whether in health or disease, admit, according to my views, of a very simple and intelligible explanation or generalization—by referring them to the nervous agency; whereas the closest investigation, conducted, according to the usual method, through many ages, has failed to establish any practical conclusion, or any that is at all satisfactory to any ingenious mind. If the observation of the different propositions of the several ingredients of the blood could lead to any useful directions in practice, it is evident that the advantage could not be generally or even extensively available; for few physicians, and still fewer unprofessional men, are capable of the minute investigations that would be requisite to arrive at any practical result that might serve to guide them in adopting remedial means.

In local inflammation there is a preternatural determination of the nervous fluid to the part affected. This determination causes the enlargement of the vessels, by extending or actively elongating the fibres of their walls, at the same time there is greater determination than usual to the blood contained or circulating in these vessels. The consequence of which determination is a change in the nature of this fluid, which, in time, unfits it for any further circulation, and it becomes stagnant. A still further change in its nature, effected by the same agent, converts the blood into a secretion, and pus is the result. The preternatural determination of the nervous fluid favors the development of heat in the part, which we have said is an animal secretion; and the unusual condition of the nerves of the part, brought about by the circumstances now enumerated, is the source of pain. Here, then, we have a satisfactory explanation of all the symptoms of local inflammation; the swelling, from enlargement of the vessels; the pain, from the unusual condition of the parts affecting the nerves of sensation; the stagnation of blood, from its unfitness for circulation in vessels that re-

quire the stimulus of blood in its normal state; the change in the color of the blood; the secretion of heat and of pus; all of which are effected by, or may be referred to, nervous agency.

Again, we have said that, at the same time that the nervous fluid is determined to the fluids circulating in the vessels or tubes, effecting changes in them, that a portion of the nervous fluid is derived thence by the afferent nerves for the supply of the demands of the general system; and it follows that, wherever there is a greater determination of blood in the vessels of any part, from that part is derived a greater supply of nervous fluid. It is with this object that there is an increased flow of blood wherever there is an increase either of muscular action or of the secretions; that is, the supply of nervous fluid adequate to the demands made to sustain these actions. From taking this view of the subject, we are led at once to adopt the very means that are found to be most effectual in relieving local inflammation. For if all the symptoms are referable to an increased determination of nervous fluid to the part, and if this fluid is supplied by the blood accumulated in the part, we should, without hesitation, resort to local depletion, as the readiest means of reducing the quantity of blood, and of cutting off the preternatural supply of the nervous fluid. We should also be readily led to adopt other means that are found to be auxiliary in affording relief in this state; we should endeavor to reduce the supply of nervous fluid in the general system, by using means to increase the excretions, and to determine the blood to other parts of the system, as by exhibiting a mild purgative, &c.; and we might be led further to reduce the supply, by attending to, and limiting, the amount of food, &c. These few remarks are sufficient to show the application of our views in practice.

The alterations which take place in the proportions of the organic elements of the blood, and in these elements themselves, are referable to the agency of the nervous fluid, which is influenced by all the causes that are observed to produce these alterations; thus abstinence from food, and loss of blood, by cutting off the natural supply of this fluid, may interfere with the formation of the corpuscles, &c. That these causes do not exert a perceptible influence on the fibrine may be owing to the fact, that the vessels being by these means emptied or thrown into an abnormal state, an impression arising from this cause is conveyed to the Mind, which instinctively determines to them a flow of the nervous fluid sufficient to maintain the due proportion of the fibrine, or even to increase its quantity beyond that point.



Sec. 707. (*a.*) From what we have already said, in relation to inflammation, it might be expected that an augmentation of the quantity of fibrine would be attendant on inflammation; as also that the quantity in the blood of pregnant women would vary, as the nervous fluid might be more or less required for the support and growth of the fœtus. In congestion of the brain, or where there are increased secretions, as in Albumenaria, or in formations of pus, we should expect a diminished formation of one or more of the constituents of the blood, as of the corpuscles, fibrine, &c., as the cessation of these secretions might be expected to be followed by a restoration of the blood to its normal state.

Sec. 708. *Chemical* Pathologists can never find out the laws which regulate the changes of the blood in the living system, which are peculiarly the subject of *Physiological* inquiry.

The retention of the materials of the Biliary and Urinary excretions, causes the accumulation of the nervous fluid which would be expended on these excretions; which, acting on the circulating mass, changes its nature, so as to unfit it for the purposes for which it was designed in the economy; and hence arise all the symptoms of disease enumerated by Dr. Williams, under the title of Necromia, or Death, by depravation of the blood.

Sec. 709. The main objects attained by the circulation of the blood in the living body are its exposure to the action of the nerves; by which means it is prepared, as it circulates, for the several stages through which it has to pass; a part of it being finally converted into the tissues, and the remainder being converted into the secretions, from which the general system is renovated, by deriving from this source its principal supply of nervous fluid. Another object attained, is the carrying off the effete portion of the tissues, which, having accomplished the end for which they were designed in the organism, are reconverted into blood, by having lost their vitality, or the life necessary for their existence as tissue, and are mixed with the circulating mass. I protest against the admission of chemical terms and chemical laws into the subject of Physiology. The science of Physiology should be considered as totally distinct from the science of Chemistry, if we would avoid error and confusion. The living organism has, properly speaking, nothing to do with the forms of dead matter; for, as soon as these latter become connected with the former, they have their nature radically changed, and are no longer subject to the same laws as formerly; consequently the terms by which these altered forms of life are ex-

pressed, should be different from what they were. It is disgusting to observe chemical and mechanical Philosophers thrusting themselves forward, like the tradesmen in the besieged city, with the view to establish laws or principles in Physiology. The inferences drawn from the actions and changes observed in the retort can have no application to the actions and changes that take place in the living organism. These latter are the result of the operation of a cause, (the nervous fluid,) of which the chemist or the mechanic takes no cognizance. Combustion, oxygen, and carbonic acid, have no place in the living body. When oxygen is brought into contact with the living tissue, as in respiration, its nature is immediately changed, and its previous form could not be recognised as it passes through the system; and when the effete portion of the living tissues are thrown out of the system, as they are in the lungs, they become subject to chemical laws, and assume the form of carbonic acid—the objects of respiration being the acquisition of nutritive materials from the atmosphere, and the riddance of the system of its effete matter.

Sec. 710. The acquisition of these nutritive materials, and the riddance of effete matter, causes an impression which is followed by a new impulse in the circulation of the blood; the regular and continuous movement, which we have said is dependent on a proper innervation of the fluids, is thus sustained until another similar impression is made on the blood vessels by the nutritive materials derived from the alimentary canal; hence we may see that the circulation is quickened, not only by respiration, but by nutrition from other sources.

The circulation of the blood is effected by the active dilatation of the heart and blood vessels, the motion of the fluid being assisted, no doubt, by the passive contraction of the same. From this view it will appear, that neither the heart nor blood vessels should be regarded as organs of impulsion, but rather as organs of suction. The difference in the diameter of the trunks and branches of the arteries is not, perhaps, deserving of the importance attached to it; inasmuch as the dilatation of both trunks and branches is synchronous, or takes place at the same moment.

Sec. 711. The movement of the blood through the arterial trunks and capillary tubes is not dependent upon the action of the heart, but upon the action of the fibres about the walls of these tubes; which, by being extended or actively elongated, draw the blood into them; although the passive contraction of the heart may assist the motion of

the fluid in some slight degree. This view explains all the variations in the circulation, which, without it, are inexplicable.

Sec. 712. The motion of the fluids in vegetables is due to the same causes as the motion of the fluids in animals—the pith, medullary processes, and woody fibres of the former, answering to the nervous system and muscular fibres of the latter. The flow of sap from the vine, when cut across, is the result of the action of its tubes; the circulation in the upper portion, so divided, is maintained by the same cause, and a partial suspension of this circulation may be caused by checking the action of the tubes, by removing the vegetable from the light, which is a stimulant to its action or a source of its life. We have heretofore described the action of tubes in conveying fluids through the living system; and have shown that when an action originates at the extremity of a tube, it is continued in successive stages through the course of the tube; thus an action commenced at the fauces is carried along the course of the œsophagus, confined to limited sections of the tube as it passes along. An action commencing at any point in a tube will also be conducted in the same way in the direction generally of the normal action of the tube. If an impression be made on the œsophagus, as by pinching or compressing it at any point, an action, consisting in a limited dilatation, is set up, which then progresses regularly towards its cardiac extremity. There is another important fact connected with the action of tubes, which has not been sufficiently attended to; it is this, that frequently when an impression is made on the extremity of a tube it seems to be conveyed through the nerves in a reverse order, and causes an action in the fibres at the other extremity of the tube; an impression on the fauces may cause an action in the cardiac extremity of the œsophagus, resulting in vomiting; an irritation at the cardiac extremity may cause frequent deglutition, and so with other tubes.

These vital laws explain the flow of the sap under the circumstances mentioned, without a reference to any “demand for fluid,” which is needlessly assumed to be a chief force in effecting this object. In the instance of the cut vine that is placed in water, the impression made by the water on the extremities of the divided tubes or sap vessels would cause an action in them that would be propagated throughout these tubes. In the instance of the engrafted evergreen, the action commencing in its leaves might be propagated throughout the whole system of the plant through its descending sap vessels; for it must be

admitted that these vessels descend to the roots for the purpose of throwing off the effete portions of the plant, thus establishing a complete circle in the course of vegetable fluids as in that of animal fluids. In the instance of the branch of the vine trained into a hot-house, besides the latter explanation, the action may originate from the *impression* made in the hot-house being propagated reversely to the vessels in the spongioles.

Sec. 713. That the circulation of the blood in the capillary vessels is owing clearly to the operation of causes independent of the heart's action is what I have constantly contended for; and so is the circulation in the arteries; and these causes are the determination of the nervous fluid to these vessels, and the consequent elongation of their fibres, and dilatation or increase of their calibres. So that any cause that serves to determine the nervous fluid to any point in the course of these vessels will serve to determine the flow of the blood towards that point, and of course will deflect its course, or interfere with its progress in any other direction. The theory of Professor Draper is, in my opinion, entitled to no regard whatever, for the reason that affinity is a chemical term, and if it has any existence (of which I doubt) it is applicable only to the phenomena of dead matter, and certainly can have no bearing whatever on the phenomena that are observed in the living organism.

Sec. 716. The facts mentioned in this and the two preceding paragraphs in relation to the circulation may, I think, be readily understood from what we said of the action of the vessels. The circulation in the vena portæ furnishes a powerful argument in favor of our view of the subject before us.

Sec. 717. To give an accurate account of the action of the heart from actual observation alone, unassisted by general principles, would be a task of the greatest difficulty, if not an impossibility; I therefore propose to furnish an account derived from observation and experiment, aided by the physiological principles which I have endeavored to establish. The blood flowing towards the heart in the superior and inferior cava is drawn into the right auricle by the active elongation of its fibres; this, the first of the actions of the heart, is attended with the temporary inaction of the tricuspid valves; and the action of the right ventricle or its dilatation by means of its fibres immediately following the action of the auricle, the blood flows into this ventricle; but as the fibres of the walls of the ventricle are elongated to cause its



dilatation, so the fibres of the columnæ carneæ become elongated; and these, together with the fibres of the chordæ tendineæ, being stiffened by the agency of the nerves, the tricuspid valves are thrust up so as completely to close the vent between the auricle and ventricle, and thus they prevent the passage of more than a due quantity of blood. The action of these fibres being nicely adapted to the action of the fibres about the walls of the ventricle, they measure off, as it were, the exact quantity of blood that serves to fill the ventricle without over distending it; which occurrence would seriously interfere with its regular function. The semilunar valves at the commencement of the pulmonary artery having their action suspended, the blood flows into this artery; which, together with all its ramifications dilating simultaneously, draws the blood into it until it is filled by a due supply of blood, which is again measured off by the semilunar valves, which are thrust forward for this purpose. These actions are repeated on the left side of the heart by the left auricle, left ventricle, and aorta, with its ramifications, and the mitral and semilunar valves of the aorta. This is, we believe, a true account of the actions of the heart. The sounds that are said to be observed in the heart may proceed from the sudden closure of the valves of which we have spoken; and the function which we have attributed to these valves may be seen to be of vast importance in regulating the flow of blood through the heart, and, indeed, through the system generally; for we see them placed in the veins, in many parts of the system, where their presence may be needed. The thoracic percussion I conceive to be owing to the elongation of the spiral or longitudinal fibres about the walls of the heart. Some persons, without reflecting on the true condition of the fibres of a muscle, and of its tendon when in a state of action, might object to the office assigned above to the columnæ carneæ and chordæ tendineæ, that they are too soft and yielding to effect such an object; but if any such person will extend his forefinger, by determining the nervous fluid to what is improperly called its flexor muscle, and resolutely continue its action by keeping up this determination of the fluid, he will not only find the finger stiffened, but he will find it a difficult matter to bend it as long as he continues the muscle in action. The extension of the finger is somewhat, or in a slight degree, assisted by what is erroneously called the extensor, but the main action is evidently in the opposing muscle; he will, by this means, be convinced that my view of this function is but reasonable.

Sec. 728. It is astonishing to observe the errors and darkness in which Physiologists have groped about, in investigating the movement of the blood in the arteries and capillaries, from a want of the light furnished by a knowledge of the truth, that muscular action consists in the active elongation of the fibres, and consequently that the dilatation of tubes is their active state. This simple general law of muscular action explains all the phenomena that have been attempted to be explained at such an infinite cost of the labor of thought, labor of experimenting, and of suffering of inferior animals from these experiments. There is no occasion for all the complexity of machinery, and complexity of the explanations of the operations of this machinery, in a process so extremely simple. We suppose that all the actions in a living body are conducted by a mind, which is the only part of a living Being possessed of the intelligence necessary for the direction of these actions. As we have before said, an impression made on any part of the living body is conveyed to the Mind, which causes the vital actions by means of the nervous fluid, which is determined in whatever direction the instincts of the Being inform it these actions are required. If at any point, or in any organ, contraction of the fibres is necessary, the nervous fluid is withdrawn by the Mind from these fibres, and determined towards the nervous centres; if it should be judged necessary that these fibres should be elongated for any purpose, the Mind determines to them the nervous fluid from the centres. In what are called, or at least in what we understand by the reflex actions, an impression made on one point is followed by a determination of the nervous fluid by the Mind to another point from that where the impression is made. In the tubes, for instance, the impression made on any portion of a tube is followed by action in another portion, commonly in the one preceding it in the course of the natural flow of its contents; thus the actions take place in the alimentary canal in a portion subsequent to that wherein the impression of its contents is made, and in this way the motion of these contents is effected. In the circulation of the blood, the impression made by the blood in a normal condition upon the right auricle is followed by the active dilatation of the ventricle; the impression on the right ventricle is followed by the active dilatation of the pulmonary artery as far as the pulsation takes place in its branches. In the minute arteries, the capillaries, and the veins, the actions, which are undoubtedly similar to those we have described, take place in such a manner, however, that the dilatations are not observable by our senses under ordi-

nary circumstances, although they may be observed in certain abnormal states. In returning through the pulmonary veins, the blood makes an impression which is followed by the active dilatation of the left auricle; the impression in the auricle by the dilatation of the left ventricle; and the impression on this latter is followed by the dilatation of the aorta and its branches, and so on through the general system. These impressions and actions are linked together in a continuous chain throughout the whole circulation; so that no one of them can be omitted or interrupted without destroying or seriously endangering the whole series; thus, an interruption of the impression on the capillaries of the lungs, as in Asphyxia, will put a stop to the *action* of the pulmonary veins; this interruption in the veins will impede the action of the left auricle, and so on, until the whole circulation is either seriously affected or entirely suspended. So it is with any other interruption in any part of the system, as by the operation of a poison, &c. Any unusual impression or unusual action of the tubes, as from moral impressions, will derange more or less the whole circulation.

Sec. 743. The object of the valves in the veins is to regulate the circulation by limiting the quantity of blood as it passes, as we have before stated.

Sec. 744. The arrest of the flow of blood in the veins by suspending the force of the heart and arteries, affords no proof that the former is dependent on the latter; it only confirms the position I have taken, that the interruption of any of the series of actions concerned in the circulation may be attended with a suspension of the subsequent actions. The freer flow of the blood into the veins of the chest, may be owing to the circumstance that when there is innervation of the muscles of the chest in inspiration, the veins also of this cavity may have an increase of innervation, and consequently an increase of calibre. The experiments of Dr. Williams on dead tubes can have no bearing on living processes. I deem it unnecessary to take into consideration the mechanical assistance to the circulation of the blood in the veins furnished by the action of the muscles; nor the aid from the force of gravity. An intelligent mind, directed by Divine Wisdom, and having at its disposal the nervous system with its fluid, and the fibrous tissues, embracing the tubes, with their contents, is amply sufficient to account for all the phenomena presented in the vital actions, without the aid of any extraneous forces whatever; and it is a clear conviction of my mind, that these actions can be and should be explained by

means of Physiological principles alone, unassisted by those of Chemistry or of Mechanics.

Sec. 746. That the received views of Physiology, in relation to the circulation, are imperfect, if not altogether false, is proved by the admission of writers on the subject, that there are peculiarities of the circulation in different parts of the system; for if the principles were general and true, they would explain the whole of the phenomena, and not leave some of them to be referred to other principles formed for the occasion. In the Physical Sciences, of which Physiology is one, a single exception should be regarded as destructive of the rule, and of course the rule or principle should be given up without any attempt to save it by referring the exceptions to some other rule. The principles I have proposed explain all the phenomena of the circulation, embracing those which are regarded as peculiarities. It is only necessary to recollect that the blood, as it passes along, is prepared to make the appropriate impressions on the parts through which it passes, to enable us to understand entirely the circulation which takes place through the lungs, through the pulmonary artery, and pulmonary veins, and through the vena portæ.

Sec. 748. This principle, together with that which sets forth that muscular action consists in the extension or active elongation of the fibres, explain the circulation as it is observed in the erectile tissues. A determination of the nervous fluid to these tissues causes all the phenomena observed. It causes the dilatation of the blood-vessels, and the consequent flow of blood to the part; it causes the enlargement and stiffening observed in organs possessed of this tissue, by actively extending and erecting the fibres by which the tissue is permeated; it delays or retards the progress of the venous blood, by increasing its vitality, to a point where it is unfitted for further circulation in the vessels, and it is only returned to the circulation by losing a part of its vitality, or by being taken up by the lymphatics. The compression of the vena dorsalis, spoken of by authors, is altogether imaginary.

Sec. 749. There are two principal sources whence the blood derives materials for its renovation as it circulates through the living body—these are the alimentary canal and the lungs or gills. At these same points, the materials that have performed their allotted office in the system are thrown off. The blood, at these two stages of its circulation, by giving off and receiving life in accordance with the great law of Nature of which we have spoken, is prepared for its further circula-



tion as it passes along, and for the fulfilment of the various purposes in the economy for which it is designed. The processes that take place at these two stages of the circulation, are intended to answer the same purpose, namely, the renovation of the materials by the agency of which the vital actions are performed. By vital actions, I here mean the movements and changes that occur in the living *body*, and not the operations of the Mind; for these latter should be considered separately, and called mental acts or actions when not inseparably connected with the corporeal organs. We have seen how the nutritive materials derived from the alimentary canal are disposed of in furnishing the supply of the nervous fluid, and of the materials that are transformed into the tissues; in the same manner I conceive the atmosphere furnishes to the blood in the lungs the materials from which the nervous fluid, and the materials of the tissue, but especially the former, are elaborated. The life which is peculiar to the atmosphere unites with the blood, and as the blood circulates, this life is transformed into the nervous fluid, and the materials mentioned, by the action of the nerves of the vessels through which it passes. Again, certain portions of the effete matter brought to the alimentary canal are thrown off by the excretory ducts, terminating in this canal in the form of fæces; and in the same way, other portions of effete matter, brought to the lungs, are thrown off in the form of carbonic acid. As the fæces are not mixed up with the blood as it circulates in the vessels, but is formed by the action of the excretory ducts, and of the nerves of portions of the alimentary canal; so I imagine that the carbonic acid is not formed in the interior or perenchyma of the organs, and does not circulate as such in the vessels, but is the product of the action of the nerves of the lungs. That the nutritive materials derived through the medium of the lungs are appropriated to the formation of any one secretion, or form of matter, as that of animal heat, is disproved by a number of facts. The nervous fluid which ministers to muscular action is largely supplied from this source; for, when exhausted by exercise, it is soon recruited by free respiration. Animals are observed to maintain a healthy condition of all their organs for a long time, with no other supply than this, as reptiles and other animals that hibernate; nay, they are sometimes known to increase the quantity of their solids. Terrapins are observed to grow fat when confined in cellars without food; and the instances enumerated of an increase of weight in the human subject without an adequate supply of food, are clearly referable to the class of cases we are considering.

The attempt to explain the vital actions by referring them to the changes in the muscular and nervous tissues, proceeds from the desire on the part of certain would-be philosophers to do away with the necessity of supposing that there is any such thing in nature as a separate immaterial existence in living beings. They consider it more rational to refer the intelligence which directs the formation of the various organs, composing the bodies of these beings, to certain cells or tissues which enter into the composition of those organs, rather than to the separate immaterial existence, called the mind or soul. The latter, indeed, if they admit there is any such thing, is, in their opinion, the effect of the operation of the former.

Sec. 750. The formation and liberation of carbonic acid after death, and in states of decay of animals or plants, cannot be regarded as having any connexion with vital actions. The actions that take place in the waste of the tissues during life are essentially different from those that occur after death, or in the dead body.

Sec. 751. We do not admit the correctness of what are set forth as facts in this paragraph. The exercise of the nerves and muscles, we do not believe, are attended by, much less dependent on, the changes in the composition of their tissues, because these actions are clearly and satisfactorily explained by referring them to other causes.

Sec. 752. There is no process in the living economy analogous or in any way similar to that of combustion. Animal heat is a secretion which, like other secretions, is the result of nervous action.

Sec. 755. It is questionable whether the life derived by aquatic animals having gills, is necessarily derived from the air mixed with the water. Why could it not be taken directly from the water as well?

Sec. 756. The air bladder in fishes seems to me to be intended as a float, into which is secreted a gas which serves to buoy up the fish in the water, and which can be secreted at will, and discharged when occasion requires, through the aperture into the œsophagus. Of the same nature I suppose are the air-sacs in birds, whose office is not that of respiration, but intended to overcome their specific gravity in order to facilitate their movements through the air. The filling of these sacs with atmospheric air would afford little or no assistance, as it would not render their bodies lighter than the surrounding medium.

Sec. 759. The lungs are membranous sacs, having their walls composed of fibres capable of contraction and elongation like muscular fibres, if they are not identical with them. The expansion or constriction of

the lungs is caused by the extension or contraction of these fibres, which are influenced by the nerves as all other muscular fibres are. From this view we can understand how narcotics or antispasmodics may afford relief in spasmodic asthma, by rendering the action of these fibres more permanent.

Sec. 760. The lungs are not passive, as we have just seen, but the action of their fibres is made, in a normal state, to correspond to the action of the fibres of the muscles of the chest. In reptiles, where there are none of these latter, in Chelonians for instance, the movement of the lungs is effected solely by the proper fibres of these organs. The fibres of the lungs are not possessed of sufficient power to overcome the pressure of the atmosphere, which is taken off from the lungs by means of the chest, so that when this pressure is allowed to take effect the lungs become of course collapsed.

Sec. 761. "The dilatation of the chest during inspiration is chiefly accomplished by the muscles of respiration placed about the chest, which, by having their fibres extended or actively elongated, expand the chest and increase its calibre. Expiration is mainly effected by the passive contraction of the same muscles following their state of action. The action of the diaphragm corresponds in these movements with the action of the other muscles of respiration. The movement of the abdominal muscles in this act, when normal, is purely incidental.

Sec. 762. Whenever there is material local affection, as in Pneumonia or Hysteria, respiration, as well as other functions, is imperfectly performed; consequently there is a more frequent repetition of the act to supply the demands of the system.

Sec. 767. The main cause of the variation in the quantity of carbonic acid, or of the effete matter given off by the lungs, is the vicarious action of other organs or parts of the system where such matter is given off; the variation from the temperature of the atmosphere is attributable to the variation in the exhalent action of the skin, &c. It is clear that the more life there is generated in the system, the more will be given off in a given time. This explains the variations from age, sex, development of the body, state of health or disease, muscular exertion or repose, sleep or watchfulness, state of the digestive process and period of the day.

Sec. 768. The same interchange of life between the blood and the atmosphere, though in a minor degree, takes place on the cutaneous surface, as in the Lungs, especially in certain animals, as the Batrachia.

Sec. 769. None of the experiments mentioned in this paragraph tend, in the slightest degree, to disprove the position I have assumed; on the contrary, they confirm that position, namely, that the carbonic acid is a form of life, composed of the effete materials of the system, modified by the action of the nerves of the passages through which it is exhaled.

Sec. 770. The changes which venous blood undergoes in the lungs are to be explained upon Physiological principles, which are entirely separate and distinct from those of Chemistry or Mechanics. The changes that occur in the blood from exposure to the air may have the appearance of, but they are not identical with, those observed in the living vessels. The air produces effects on animal fluids and animal tissues recently cut off from the living system; but these effects are not precisely the same with those produced by the agency of the nervous fluid. These latter are the only changes that should be recognised as belonging to Physiology.

Sec. 773. Water, when it passes into the living system, is vitalized by the action of the nerves, and is converted into the fluids and tissues; it no longer continues in the form of water, but is reconverted, when about to be thrown out of the system, by the exhalents; but it is not even then pure water, but a fluid modified by the changes it has undergone in the system.

Sec. 777. Asphyxia from the respiration of certain gases, and Coma from that of oxygen, are all to be attributed to changes produced in the blood, which unfit it for its regular circulation. The same may be said of Asphyxia, caused by the suspension of respiration.

Sec. 779. The retardation of the blood in the capillaries, which is the condition termed Congestion, is caused by a change in the nature of the blood from whatever cause. By this means the series of actions which we have seen constitute the circulation is interrupted, and consequently a greater or less interruption takes place throughout the whole series; thus the impression on the capillaries not being normal, the action of the veins is affected; the impression on the veins not being proper, the several actions through the heart are interfered with, and so on.

Sec. 780. The phenomena observed by Dr. Reid, in his experiments, were, I think, misconstrued. The force of the impulsion of the fluid in the arteries was no measure of the action of the arteries or of their distension, but it furnished the evidence of just the contrary or



opposite condition of these tubes; for, as their action was diminished, their contraction would be increased, and consequently the impulsion of their contents would also be greater. The Hæmidynamometer is calculated to lead to monstrous errors in practice, and to erroneous inferences in theory.

Sec. 781. At the earliest period in the existence of a living Being, at which we can convince ourselves of such existence, we recognise certain movements or operations which are undoubtedly the result of intelligence. We unequivocally observe means made use of for the attainment of ends, and this, too, in a continuous series; one act being done preparatory to another, this to something further, and so on; which presupposes the high degree of intelligence called *Invention*. Cells are formed which, by their multiplication, form tissues; these last go to the formation of organs, by means of which are performed the several functions necessary to the maintenance of the perfect organism which constitutes the material part of the individual. The question, which is the most important one in the whole Science of Physiology, here arises, namely: To what are we to refer this intelligence? Is it, as Physiologists seem generally to believe, inherent in certain forms of matter called *Cells*, which are said to be capable of propagating themselves, but whose individual term of existence is very limited—the intelligence being constantly transferred to the innumerable progeny of cells which contribute to the formation of the tissues and organs? By means of this intelligence in the cells they are enabled, it is said, to select from the current of the blood, as it passes, the materials necessary for the growth of the tissues, of which these cells are constituent parts; and, what is still more wonderful, these intelligent cells, innumerable though they are, all work together in harmony for the common good of the whole organism—not only constructing the organs for the performance of certain functions, but actually being intimately concerned, if not the sole operators, in performing these functions! It follows from these physiological views, and the inference is strongly advocated, that these cells form the brain; and then from that peculiar arrangement of the particles of matter composing it, of which they have the disposal, they give rise to thoughts which are nothing more than the secretion or operation of the brain. The Mind or soul, of which the modern school of Physiology take no cognizance whatever, is considered by them as altogether imaginary, or at least to be nothing more than the result of the operation of the brain, or of the intelligent cells composing the brain!

The other reply to this question, and it is the one which we unhesitatingly adopt, is, that this intelligence is referable to an existence which is not material, but which evinces itself by its operations. This immaterial existence emanates from, or is created by, Him who is the fountain and source of all intelligence, and who is properly regarded as the Creator, the Designer or Architect, and the Supreme Governor of the World and of all things in it. This existence, which is what should be understood by the term Mind or Soul, is endowed by the Author of Nature, at the time of its creation, with certain faculties or talents, by the due exercise of which certain functions or acts are performed, which he has appointed in order to carry out his designs. To instruct his creatures, or to direct them in the performance of the actions required of them, he has implanted in, or stamped upon, the immaterial existence in which they originate, or first enter upon their present stage, his commands, which are the instincts, and which are indelibly impressed on every living being. The operations, then, which we first observe in a living being, are the acts of an intelligent mind, guided and directed by a Supreme Wisdom, and have relation rather to the vast designs of the Creator, than to any definite object which the individual proposes to itself. So it should be in regard to the actions of living beings in all other or subsequent stages of their development. The objects we should propose to ourselves in all our actions, should be the observance of His will, and the performance of the duties assigned to us, and not the accomplishment of our little selfish ends. Living beings are so constituted that certain external conditions are necessary, in order to the obedience of the instincts. Impressions on the senses from without are necessary to the exercise of the senses. Impressions arising from the presence of food are necessary to the gratification of the appetite for food. The impressions arising from certain seasons of the year, &c., are necessary, in many animals, for the gratification of the venereal appetite. A knowledge of this law of Nature is a matter of the utmost importance to mankind, by enabling them to adapt means to the attainment of some of the most desirable ends; for this law, together with that formerly referred to, namely, that the happiness or well-being of all living beings results from a proper gratification of their instincts, enables us to promote the growth or development of animals and vegetables, by providing the conditions necessary to this end. In husbandry and in agriculture, in raising stock, and in raising agricultural products of the

vegetable kingdom, we should attain our ends much more certainly and effectually by having constant regard to the two laws of which I have just spoken, than by making the vain attempt, founded on chemical laws, to provide the chemical ingredients that are to enter into the composition of animals and vegetables. Here again I would take occasion to advert to the advantage, if not the necessity, of separating the subjects that belong to living beings from those that belong to dead matter, if we desire or are to expect any benefit from the advancement of Physiological Science. The laws, which are the true objects of science, that belong to these two forms of matter, are totally separate and distinct, and should be so regarded in all our investigations. Physiology has its laws peculiar to this science, to which all the phenomena connected with life are to be referred, and these laws have nothing in common with the laws that properly belong to Chemical Science.

Sec. 781. Albumen is not a dead or inert substance when it is circulating in the living tubes, but it is the product of the action of the nervous fluid on the nutritive materials taken into the system. It is the result of the first change that takes place in these materials, as fibrine is the result of the second change; the one is as much the product of vital action as the other, and both have vital properties peculiar to themselves. The formation or growth of the various tissues is another change that takes place in the nutritive materials when moving through the vessels, and all these changes are effected solely by the agency of the Nervous system, which, by imparting to, and at the same time abstracting somewhat from, these materials, transforms them into the forms of matter of which we have been speaking.

Sec. 782. A sufficient reply to the views contained in this paragraph as a whole, may be found in my general remarks on section 781; so that, instead of arguing against the positions taken by the author seriatim, I will simply state my views of nutrition, or of the growth of organized bodies.

I believe, then, that the mind or soul of each individual, under the guidance of its instincts, forms the several portions of its body, and that it does this solely by the agency of its Nervous system, (for I assume the position that all living beings have a Nervous system or its analogue,) by which means alone is the mind brought into relation with, or can operate, or be operated on, by matter or the material world. In the development or growth of the several portions of the body, the nerves are first developed, and are so constituted, I conceive,

as to act on the fluid transmitted through them by the mind ; altering its nature so as to enable it to transform the fluids brought to them into the requisite tissue.

My views on this subject may perhaps be somewhat illustrated by referring to what takes place in the vessels and blood in its transformation into the secretions. In its transformation into the male semen, for instance, the blood is seen to permeate the spermatic artery, which is extended in its various and intricate convolutions to a very extraordinary length, evidently with a view to its exposure to the action of the nerves in the walls of the vessel ; by which means the blood itself is prepared by the changes effected in it, in the various stages of its progress, for its final conversion into the semen. Just so, we conceive, the nervous fluid, in passing to its destination, has its nature so changed that it is fitted, when arrived at its allotted place in the body, to convert the nutritive fluid presented to it into the tissue suited to that portion of the body ; the actions all along being directed by the intelligence of the mind, instructed by its Creator, and these actions being not at all dependent on the intelligence or direction of the matter engaged in these changes, *or on any elective affinity possessed by this matter*. I mean distinctly to assert, as my belief, that the part performed by the mind, in the above changes, is simply that of directing the nervous fluid through the nerves which it has the power to do ; and that the changes which occur in consequence, take place in accordance with certain laws of Nature, which appoint, that when the nervous fluid circulates to a certain extent through the nerves, it shall be so fitted, or that when the blood has been subjected so long to the action of the nerves, it shall be so converted. With the construction or establishment of these laws of Nature, neither living beings nor matter have any thing to do ; for they are the work of Him who is the Supreme Governor of the world.

Sec. 783. What are called the parent cells and germinal centres are nothing more than the stages in the development of the tissues—the processes of which development, we have seen, are referable to the mind.

Sec. 784. The phenomena presented in the operation of certain agents, as poisons, on the living body, may be explained without the aid of the “*selecting power*,” which is attributed to the germs of cells. These agents may operate more or less injuriously on particular nerves, or parts of nerves, which may be so constituted as to be more liable to



be affected by them; so that abnormal actions may take place, more readily in these than in other nerves, from the deleterious impressions made on them; thus, the nerves belonging to the extensor muscles of the fore-arm, may be more sensibly affected than other nerves in the body, by the impression of the lead which is diffused through the circulating mass; and this increased sensibility of the nerves would cause a greater flow of the circulating mass into the parts to which they were distributed than to other parts; and in this way there might be even a preternatural accumulation of the poisonous material in the parts thus affected. The symmetrical nature of the affection is some confirmation of the correctness of this view; as nerves similarly constituted would probably be similarly affected. When the poison has accumulated in an organ to a certain extent, the nerves becoming diseased, there would be a less determination of blood by the organ, as in paralysis from lead.

Sec. 786. The increased amount of tissue, connected with increased functional activity of any organ, and its diminution connected with diminished functional activity, is owing to the fact, that in the one there is a greater determination of the nervous fluid to all the nerves of the organ than in the other. The consequence is, a greater flow of the nutritive fluids to the organ, and a greater variety of changes in these fluids, which result in the formation of the solid tissues of the organ.

Sec. 787. The hypertrophy of the heart and bladder, from the causes mentioned, is not owing to the propulsive efforts of these organs, but rather to an opposite action, that of an effort to expand or dilate themselves, which is the only active state of these organs.

Sec. 788. Bronchocele is caused by some deleterious agent that affects the nerves of the thyroid gland; the changes in the structure of the gland being brought about by the impressions on its nerves.

Sec. 789. As an increased supply of the nervous fluid on the general system, or an increased determination of it to any organ or part of the body, causes general or partial hypertrophy, so a diminished supply in the system generally, or a diversion or expenditure of it in any part, causes general or partial atrophy. The most usual cause of atrophy is an expenditure of the nervous fluid on one or more of the secretions, as in the increased formation of urine in diabetes mellitus. The formation of pus in phthisis, &c.

Sec. 790. There is no necessary connexion between vital operations and acts of nutrition, although they are, as we have shown, incidentally connected.

Sec. 792. The reunion of parts that have been separated from the body is a very simple process; for it is only necessary to place the parts in apposition, and so retain them until the nervous fluid finds its way between the divided extremities of the nerves; when acting on the several tissues of the separated part, they restore the action of the tubes and other parts, and heal the breach that had been made. There would be no occasion for the reproduction of a large number of very different structures. The manner in which growths are effected in the living body, we have already attempted to explain. An irritation, or preternatural impression, will call forth an unusual determination of the nervous fluid to any part, and consequently an abnormal or morbid growth.

Sec. 793. The various phenomena presented in the healing of wounds, about which so much has been written, and such a variety of opinions expressed by surgeons, may be explained in a few words. Whenever the impression on the mind, arising from injury to the part, or from external circumstances, as exposure to the air, &c., is barely sufficient to call forth a determination of the nervous fluid necessary to the restoration or reunion of the wound, there are none of the ordinary symptoms of inflammation, such as an enlargement of the adjacent vessels, &c. The wound is healed by what is here called the modelling process. It may be healed, however, by a still more simple process, that of simple apposition of the divided parts of which we have spoken in the last paragraph. Both of these modes of the healing of wounds are comprehended in the expression of union by the first intention. These two processes are so similar, that they may, without detriment, be regarded as identical; the only difference between them being, that in the one more tissue is required to be formed than in the other, and consequently the process is more complicated, and requires greater attention on the part of the surgeon.

When a stronger impression is made on the mind by a more serious injury to the tissues of the part, or by the exposure of the surfaces of the wound to the air, &c., then there is a determination there of the nervous fluid, more than sufficient for the purposes required; the consequence is, that the adjacent blood-vessels are enlarged, their contents changed in their nature, and, finally, converted into the solid tissues; and thus granulations are formed, and the vessels in these latter take on a secreting action, and pus is the result. All these phenomena, which are the ordinary symptoms of inflammation, naturally result from

the preternatural determination of the nervous fluid to the part, which the mind instinctively directs on receiving the unusual impression, provided the whole system is in a healthy state. The secretion of the pus is the only means by which the superabundant nervous fluid can be got rid of consistently with the integrity of the tissues. If it is not so expended, the fluid accumulating in the nerves of the part, destroys their natural function and they perish, together with the tissues dependent on them, and sloughing follows.

If the determination of the nervous fluid, by the Mind, to the wound be deficient from any cause, as from an abnormal condition of the system, resulting from violence to the whole nervous system, by which its function is impaired, from exhaustion of its nervous fluid by increased secretions, &c., then the vital actions in the wound become inadequate to its reunion, the parts appear pale and flaccid, and all salutary processes are suspended.

Sec. 795. There is no occasion to regard fibrine, coagulable lymph, and the colorless corpuscles of the blood, and the cells into which they are said to be formed, in any other light than as being the various stages through which the blood passes when being converted into the tissues by the agency of the nervous fluid.

Sec. 802. It seems to me that the author has been led to the adoption of the most erroneous, not to say monstrous, Physiological and Pathological views, simply from a desire, which seems a fashion of the times, to overlook the agency of the Mind, acting through the medium of the nervous system, in bringing about or causing the vital actions. But is it not unphilosophical to reject explanations that are simple, rational, and entirely satisfactory, and adopt others of opposite qualities, merely because they are more in accordance with prevailing errors? Blood has no power in itself to undergo changes, much less can it effect changes in the tissues; for all such changes are referable to the agency of the nervous fluid, determined by the Mind. The plastic element of the blood is nothing more than the result of this agency. The stagnation of the blood in the vessels we have formerly explained, as arising from its excessive vitalization, which unfits it for further circulation; and its conversion, through the various stages of fibrine, coagulable lymph, white corpuscles, &c., into the tissues, has likewise been shown to be the result of a further vitalization brought about by nervous agency.

Sec. 803. We repeat, the blood has no formative power, and it is

absurd to imagine a fluid plasma capable of spontaneously passing into simple forms of tissue. These changes are the result of the operations of an intelligent Mind, instructed by an infinitely superior intelligence than that which itself possesses.

Congestion consists in a stagnation of the blood, caused by the preternatural dilatation of the vessels, by reason of the change in the nature of their contents, or from any other cause. This change in its nature may also render the blood, or its serous portion, more liable to transudation.

Sec. 804. We have already explained the phenomena of sloughing, or gangrene, section 793; the loss of substance in an abscess is also referable to derangement in the nervous function; the nervous fluid being abstracted, by which means the tissues are returned to the form of fluid, and passes off with the other effete fluids; and the nervous fluid proper to the part is diverted into the formation of the products of inflammation, as fibrine, coagulable lymph, pus, &c.

Sec. 805. Pus is formed by a change in the blood, superinduced by nervous agency. The reason why pus is formed in inflammation is simply because, in this condition of a part, there is an unusually increased determination of the nervous fluid to the part, and especially to the blood circulating in the part.

Sec. 807. Tubercular matter is probably owing to the process of assimilation or nutrition being imperfectly performed; which imperfection is unquestionably the result of some derangement of the function of the nervous system. Habits that are liable to strumous disease, are remarkable for some peculiarity in the development of the nervous system; hence they are said to be of a nervous temperament. The changes that take place in the nutritive materials in the several stages through which they pass, may be faulty in these stages, as well as in that wherein it is finally converted into the solids; so that this matter may be, as it undoubtedly is in many instances, the product of an extensive derangement of the nervous function.

Sec. 809. In what are called cancerous or fungous structures, the nerves of the part become diseased, in consequence of the diseased secretions or products of the morbid inflammation giving over to the afferent nerves of the part a vitiated fluid, which, in its turn, is a source of unusual irritation to the system, and causes a morbid change in all the functions of the part. The consequence is, an unusual formation of the morbid growth, in which the disease consists.



Sec. 810. In this paragraph the author exhibits much confusion of thought, and renders his meaning ambiguous, by using the term *Life*, which he considers a *state* of vital action; but if he had substituted for this term the expression *Vital action*, his meaning would have been more intelligible, and his views more correct. It is true, that each part of the organism has an individual action of its own, whilst contributing to uphold the general action of the entire being. This action of the entire being depends upon the due performance of the functions of all the subordinate parts, which are closely connected together. The application of this remark will be readily seen throughout the whole of his views on this subject, but when he suffers this meaning of the term to slip from his mind, and attaches the notion of personal identity and of intelligence to individual parts of the living body, then his views become absurd and ridiculous, if they are capable of any meaning at all.

Sec. 811. The doctrine of the development of cells is, as I have frequently remarked, absurd, and altogether unworthy the attention of any sound mind. The vital actions of a living being have but one source, and that is the Mind of the being; and the Mind of a living being is the only part of it possessed of the intelligence necessary to direct these actions or conduct these operations. Cells have no personal identity; they neither absorb, secrete, assimilate, nor elaborate anything; neither do they originate or produce other cells, nor do they originate from pre-existing germs. They are nothing more than the forms which the nutritive materials are made to assume, as they are being converted into the living tissue, or into the tissues of a living being. They have such duration as is allowed to them, in order to carry out the purposes of the Mind in the formation of the organism. Certain parts of the organism may have their forms changed more slowly than other parts, such as the heart wood of plants, the bones of animals, &c.; but there are constant changes taking place even in these parts, so long as they are under the influence of the Mind, or belong to the living organism. It would be a gross error to consider them as being alive, merely because they retain their form when removed from the organism to which they belonged; for this very removal from vital influence is the cause of their remaining unchanged. The reason why the heart wood of a plant may decay, without seriously affecting its subsequent growth, is, that at regular intervals in its development large nervous centres, or what are equivalent or analogous to them, are

formed, which supply effectually the place of the original centre, medulla or pith.

The separation of the living organism, or parts of that organism, from the vital principle, that is, the Mind, constitutes what is ordinarily understood by the term Death; but the author's erroneous views of Physiology lead him to the absurd conclusion, that as long as the structures of animals hold together they are not in reality dead, though they may have been separated for an indefinite time from the living organism—their death taking place only when the structures decay!!! To such monstrous errors does the doctrine of cell-growth, which appears to be a favorite hypothesis with the author, lead.

The difference between the original existence of Man and that of a Polype, is, that the one is endowed by the Creator with faculties and instincts totally distinct from those of the other. Directed by these instincts, and exercising these different faculties, they form bodies, perform functions, have enjoyments and sufferings, altogether differing the one from the other. These endowments would form the proper basis of a classification of living beings.

Sec. 813. It is true, that "it is a necessary consequence of that intimate mutual dependence of the several operations, which is characteristic of the higher organisms, that the interruption of the function of any one important part is followed by the death of the whole structure; because it interferes with the elaboration, circulation, or depuration of that nutritive fluid which supplies the pabulum for the growth and reproduction of each portion of the system." The immediate cause, however, of the death of the organism, is its separation from the influence of the Mind. The Mind, from the circumstances mentioned, having lost the means of exerting its influence through the medium of the nervous system, loses altogether its hold on the organism, and the latter perishes in consequence.

The distinction drawn between somatic and molecular death is entirely useless, and, indeed, is altogether unfounded. There is but one form of death, and that is dependent on one cause only, namely, that which we have mentioned. The body is but the tabernacle of the Mind, and when the Mind has quit it, it is nothing more than dead, inert matter.

Mortification and its extension is owing to the disorganization or loss of function of the nerves of the part affected.

Sec. 817. The principal object attained in the living economy, by

means of the secretions, seems to have been entirely overlooked by Physiologists. This object is not the separation of certain elements of the blood in order that the rest may be converted into the solid tissues, neither is it the collection of the impurities from the system, that they may be eliminated; but the great object of the secretions is to furnish the materials out of which the nervous fluid or life of the being is supplied. This is proved by the fact that, whenever the secretions are interrupted, vitiated, or suspended, the vigor, strength, or power of the individual is affected, and that, too, in an exact proportion to such interruption, vitiation, or suspension, and to its occurrence in a secretion, that is more or less important in the economy. Again, when the receptacles, wherein the secretions are stored up, for the object mentioned, as the urinary bladder, the colon, the gall bladder, &c., are emptied, the system at large is immediately and sensibly affected by this loss of the nervous supply. It is beneficially affected when these discharges are normal; and injuriously affected when they are inordinate or abnormal.

The formation of the solid tissues, of whatever kind, of calcareous matter in the bones and teeth, of chondrine and gelatine in the bones and cartilages, and of horny matter in the cells of epithelium and its appendages, (hair, nails, hoofs, &c.,) is accomplished by a process *altogether distinct* from that concerned in the formation of other products which are properly considered as secretions. The serous fluid which distends the interspaces of areolus tissues, the oily matter contained in the fat cells, the albuminous fluid of the humors of the eye, &c., are properly considered products of the latter kind.

Sec. 818. It is utterly impossible to arrive at any just conclusions in relation to the processes taking place in the living economy, merely by paying attention to the solid and liquid aliment taken in, and to the matters separated or excreted as solid tissue may be formed or decomposed without the process being affected by what is taken in, or without being exhibited in the excretions. Much nutriment is undoubtedly received from the surrounding medium, and much of the materials of the body given off to it.

Sec. 819. The excretions are nothing more than the portions of the secretions remaining after they have performed their office in the economy, and which is eliminated because of no further use. The chief source of the secretions, we have before shown, is the blood, changed and elaborated by means of the nervous fluid. The solid

tissues, by losing the nervous fluid which formed them, by combining with the blood, are thus again resolved into blood, and may be reconverted into any other form of matter produced from the blood, and not necessarily into the particular forms called urine and bile.

The blood does not, during its circulation, give up one portion of its constituents in one part of the body, another in a different situation, and so on; but the formation of the tissue in any part of the body is the work of the nerves of that particular part, which, having prepared a fluid suitable for this purpose, convert the blood presented to them in its circulation into the required tissue. But it must not be lost sight of that the Mind, prompted by its instincts, determines the nervous fluid into these nerves, to be converted by them as shown. I think that no regard is due to the chemical distinctions of azotized and non-azotized matter, which is so much insisted on. They seem to me to be inapplicable to any useful practical purpose.

Sec. 821. The change produced in the blood by the agency of the nervous fluid which converts it into the secretions, unfits it for the other change, produced also by the nervous fluid, which converts it into the solid tissues. The chemical views entertained by the author affords him no assistance in understanding or explaining the laws of Physiology. They lead him to confound objects that are distinct in their nature, and to misapprehend subjects that are more intelligible without them.

Sec. 821. The reason why certain forms of matter, as certain tissues or certain secretions, are formed in one part of the system, and other forms of matter in a different one, may be referred to the special endowments of the *nerves* of the part where such forms of matter or of life originate. The cells, where they have any existence, are nothing more than the incidental stages that occur in the conversion of the blood into new forms, or they, or rather that form of cell seen in the follicles of the mucous membrane, &c., may, in some instances, be the parts at which the nerves in their development, for any special purpose, receive their special endowment that fits them for such purpose. Pus, mucus, and some other secretions, are said to have been observed proceeding from such cells.

Sec. 822. There is in reality no such thing as a secreting cell, secretion being an operation performed by the agency of the nerves alone. There is no fatty matter in the blood in its normal state, but this matter is the result of the action of the nerves belonging to the adipose tissue. It is a gratuitous assumption that the secreting pro-



cess is performed by cell growth. The cells of the secreting tubuli or follicles do not select any particles from the blood, for they are not possessed of the intelligence necessary to enable them to do so. Neither do the cells at the extremity of the intestinal villi select from the contents of the alimentary tube, the nutritious portion which is to be introduced into the absorbent vessels; but the nerves situated in these parts are so constituted as to be sensible of the impressions made on them; and when these impressions are suitable, the Mind prepares the way for their further progress in the system, to accomplish the purposes it may have in view, which are dictated to it by its Creator. There are passages between the vessels of the glands, wherein the secretions are formed, and the excretory duct or ducts; and these passages are only rendered permeable as a consequence of impressions made by a normal state of the secretion; and when the secretions are abnormal or vitiated in any way, they may re-enter the circulation, and pass along with the blood. The distinction between growth and secretion is very plain, the object of one being simply the formation or extension of the solid tissues of the body; that of the other, the preparation of a subtile fluid, the nervous fluid, by the agency of which all the acts and changes in the system are accomplished.

Sec. 824. The difference between secretion and transudation, or the passage of the matter secreted and the matter transuded through the membranes, is, that in the one the passages just referred to are opened by a vital act; in the other, they are opened by a physical act, or by the loss of their vitality. In other words, in secretion the process takes place in accordance with vital or physiological laws; in transudation, with physical laws.

Sec. 825. The secretion of bile furnishes a considerable supply of the materials that are wrought into the nervous fluid, or life of animals; for these materials, in the form of a subtile fluid, undergo changes, I conceive, as they pass through the afferent nerves, analogous to those that take place in the blood as it circulates, or in the nutritious fluids as they pass along to be converted into blood. We are very sensible of the suspension or material derangement of this secretion, which is attended with a peculiar sensation of debility, and an impairment of the nervous functions generally, evinced by head-ache, and more or less interruption of the functions of many important organs.

(a.) The supply of the materials for the nervous fluids, if diminished from one source is increased from another; hence, if respiration, which

is one of these sources, is greatly developed, as in insects, there will be less occasion in the system for a large supply from the liver, and vice versa when the liver or other secretory organs is largely developed, as in mollusca, &c., there will be less occasion for other sources of supply; and as the number of the sources is increased, there will be the less occasion for an extraordinary development of any one of them, as is seen in the higher order of animals, where these sources are numerous, but none of them greatly predominating. But in the Carnivora and Rodentia, which require an extra supply of the nervous fluid corresponding with the energy of action demanded in their mode of life, the liver is more than usually developed.

The gall-bladder is a receptacle for the bile, whence is constantly derived a supply of the materials for the elaboration of the nervous fluid. When it is absent, the supply is derived from the bile in its passage through the hepatic ducts and intestines. The coats of these ducts act like those of all other tubes, the fibrous coat causing the movement of their contents by dilating and contracting their calibres; and the projections of the mucous coat acting like the valves of the veins regulating or modifying this movement.

Sec. 826. The liver may be regarded as consisting of a number of lobules, each of which is made up of a congeries of nerves and tubes, embracing branches of the vena portæ, of the hepatic artery, and hepatic veins, and of the excretory ducts. There are also in each of these lobules branches of the lymphatics, which take up the secretions in order that they may be more entirely exposed to the action of the afferent nerves—the blood being converted into bile by the action of the nerves on the contents of the hepatic artery and vena portæ. The necessity for a largely developed liver in the fœtus or embryo is apparent from what we have before said, as much nervous fluid is required for the purposes of growth, and other sources of supply are cut off in this state. The reason for its diminution after birth is also plain, for these sources of supply are then provided, as respiration, the exercise of the lungs, &c.

Sec. 827. (*Omitted.*) It is questionable if the congestion here spoken of is venous. Any cause that alters the nature of the blood so as to unfit it for circulation arrests its progress and causes congestion. This delay in the instance before us, as in most other instances of congestion, probably occurs in the capillaries where the changes take place that prevent its passing over, either into the veins or into the

ducts of the secretions. The passages from the extreme capillaries into veins and into these ducts I conceive to be very similar in form, but differing in the sensibility with which they are endowed. The nerves of one kind being sensible to the impressions made by the blood, and the nerves of the other kind of passages being sensible only to the impressions made by the secretions. Consequently the passages are only permeable by their appropriate fluids.

Sec. 832. The blood may undergo changes in its circulation through the liver, by which it may be approximated to the nature of bile, or indeed an imperfect bile may be formed without passing into the biliary ducts, but which is returned into the circulation with the blood, and gives rise to jaundice and the symptoms accompanying this disease. In such a state of things mercurials, by exciting the ducts to action, may be the means of opening the passages so that the bile may pass off into these ducts.

Sec. 833. In most, if not in all, chemical analyses of subjects that belong to Physiology, "the component parts that are enumerated are not true *educts*, but are *products* of the operations to which these subjects have been subjected." So that I have learned to pay little or no regard to conclusions drawn from such operations.

Sec. 834. The action of the biliary ducts is similar to that of other ducts; the impression made on the extremity in the intestine is followed by increased action, commencing from the other extremity; as the impression in the stomach, or at its cardiac extremity, produced by hunger, causes an increased action in the œsophagus throughout its course, but commencing at the fauces; the impression made by irritating the fauces causes an action, commencing at the cardiac extremity; an impression made on the rectum causes an action, commencing high up in the intestines; and if made at the extremity of the urethra, the action may commence at the urinary bladder, or in the seminal ducts, &c.

From this view of the subject it is easy to understand how the secretion of bile bears some proportion to the food digested; how there is no occasion for a Gall-bladder in animals that are constantly ingesting food; and how some receptacle should be provided for a secretion that is constantly going on in such animals as take their food at intervals; and we may also understand why the bile should accumulate in this receptacle when no food is taken, as in starvation.

Sec. 835. The operation of the bile on the nutritious contents of the alimentary canal is the same with that of other secretions that con-

tribute towards digestion ; that is, a quantity of nervous fluid which enters into its composition is thus intimately mixed up with these contents, and effects in them the changes necessary for their progress into the system.

Sec. 837. The conversion of chyle into blood is solely referable to the influence of the nerves, the blood having no agency whatever in bringing about the change. The lungs and liver are points at which the elements of the effete materials of the system are given off, according to the law of nature, that where life is received there it is given off.

Sec. 838. We have already given our views so fully of the mode in which the secretions are formed, and of the ends attained by them in the living economy, that we deem it unnecessary to repeat them, as all the secretions are formed in the same manner and perform the same, or nearly the same, office; the difference among them being, that some of them are used directly in effecting changes in the nutriment that is to be converted into the tissues; whilst others are used indirectly for the same purpose, as well as for other purposes, by supplying the materials for the nervous fluid. To the latter class of secretions belongs the urine. The corpora malpighiana are analogous in appearance and in function to the lobules in the liver. The renal capsules and corpora Wolfiana prepare secretions that are essential in the economy of the fœtus—supplying the materials for the nervous fluid—as are also the secretions or contents of the allantoës, and of other membranous sacs connected with the fœtus.

Sec. 840. The water circulating with the blood seems to be peculiarly suited to the sensibility of the passages which transmit the urine into the urinary ducts. By this arrangement the excess of water in the blood is soon drained off by the kidneys.

Sec. 853. The use, in the economy, of the action of all glands, is the preparation of materials for the elaboration of the nervous fluid ; the elimination of matter whose retention in the circulating current would be injurious, is incidental and of secondary importance. The structure of the mammary glands is very similar to that of the other glands, of which we have spoken, consisting of lobules and follicles wherein the blood is converted into the secretion, and the latter passed over into the excretory ducts. These ducts are similarly constituted with those of the liver and kidneys, and may, like them, have their action aroused at their commencement by impressions made on their



extremities ; the act of sucking producing an increased flow of the secretion into the ducts, as well as an increased action in the course of the ducts.

Milk differs from other secretions, except the semen, in this, that it is intended not so much for the benefit of the system in which it is formed (although the advantage to the system in a variety of ways is considered) as for an ulterior object—the sustenance of the young. The object which is principal in other secretions being in this secondary.

Sec. 854. The changes that take place in milk, after its separation from the living system, are explained more readily, and I think more rationally, on principles different from those of chemistry. The union of the life of the atmosphere with the constituents of milk in different proportions furnish such explanation; for instance, a certain quantum of this life, combining with certain constituents of the milk, may form cream; another quantum of this life, which is brought into intimate union with certain constituents of the cream by churning, may, by combining with these constituents, form butter, &c., &c. Acids or the rennet, by interchanging life with the atmosphere, may bring such a form of the life of the latter into contact with the milk as may be suitable to its conversion into curds.

Sec. 862. The saliva belongs to the class of secretions that are immediately mixed with the nutritious fluids contained in the alimentary canal, in order to superinduce changes in them that fit them for their progress towards other changes which result in the formation of the tissues, &c. The process by which it is secreted is the same with that of other secretions.

Sec. 865. The secretion of the lachrymal glands requires no special account.

Sec. 866. The striking peculiarity in the anatomical structure of the testis is the extent to which the blood is exposed to the influence of the nerves in the lengthened spermatic artery, and still more especially in the length of the ducts which the semen traverses in order to its preparation for its final purpose; by which means it is perhaps more perfectly vitalized, or more highly elaborated, than any other secretion. In other respects this secretion is similar to others, that is, in its formation and purpose. Like the milk, however, it is destined to an object ulterior to the purposes of the system wherein it is formed; although most important to the well-being of that system, in furnishing a large

amount of materials for the elaboration of the nervous fluid. This is remarkably shown in the debility and prostration of the powers of the system, which occurs when the semen is exhausted by an act of coition, or when this secretion is suspended or interrupted in any way.

Sec. 868. The main object attained by the cutaneous secretion is the formation of nervous fluid; but it also relieves the system of any excess of this fluid that is completely elaborated, by its expenditure in the formation of this secretion.

Sec. 873. Besides the purposes answered by the cutaneous secretion mentioned in the last note, the secretion from the mucous membranes of the alimentary canal answer the purpose of being combined with the contents of this canal, and altering their nature by means of the excess of nervous fluid which they contain.

Sec. 877. What the writer supposes to be putrescent matter in the secretions of the intestines are nothing more than vitiations of these secretions; when they are normal they are not putrid.

Sec. 878. The division of the nutritive materials into two classes is attended with no practical benefit. The living system requires a certain amount of these materials, to be possessed of certain characters; and if this amount or these characters fail or are defective, the system suffers proportionally. All the changes that take place in these materials are the result of nervous agency. The remedy for any abnormal changes should be sought in the modifications of this agency. The increased supply of the lithic acid, for instance, which is the consequence of an accumulation of the nervous fluid somewhat vitiated, is remedied by confining the ingesta to substances that furnish less of this fluid, and that of a more simple character, as farinaceous food, &c. On the contrary, there may be conditions of the system wherein the nervous fluid may be defective, either in quantity or quality, as occurs in the strumous diathesis, where such defect exists in some stage of the progress of the nutritive materials; and which is to be remedied by supplying the deficiency by generous diet and other appropriate means.

Sec. 880. Primary disorders of the circulation of the blood are not frequent. There is a view of this subject that I consider of the greatest importance that seems to have been overlooked; it is, that an impression made on any point in the progress of the nutritive materials gives rise to action or to actions, which are propagated throughout the whole subsequent course of these materials; the action in one point giving rise

to that in the next subsequent one, and so on through a long series. But what is most important is, that such actions are liable to become morbidly or abnormally developed in any part of their course. Thus an impression acting on the stomach may give rise to morbid action or disease in the lungs and heart, &c. In hard study, when confined to attentive reading, the action of the brain is increased for the purpose of exercising the sense of light; and, in other forms of study, that in exercising the several faculties of the Mind, there is instinctively an increased determination of the nervous fluid to the brain, that it may be in readiness for any occasion that might arise. This is merely accidental, but it has served to give rise to the monstrous error on the part of Physiologists, *that the brain is the organ of thought*; whereas it is simply an organ which the Mind makes use of, in common with the other bodily organs, to carry out its designs.

Sec. 881. The writer here plainly avows himself as an advocate of the Humoral Pathology, which I think I have shown to be unfounded and erroneous, unless we regard the nervous fluid as one of the humors. To attribute the changes in the system to the agency of the blood is, to my mind, ridiculous in the extreme, and unworthy of serious refutation.

Sec. 882. The phenomena referred, in this paragraph, to sympathy, may be understood by considering the fact that the nerves of the same tissue, structure, or membrane, in whatever part of the body, are endowed with the same sensibility to impressions made on them by any of the constituents of the circulating mass or fluids; consequently, they are all nearly simultaneously operated on by any morbid cause existing in these fluids. This equality of sensibility also exists in the same parts or organs, on the two sides of the body, and accounts for their being often similarly affected.

Sec. 884. The increased secretions spoken of here relieve the system by taking off the excess of nervous fluid that has accumulated in consequence of the abnormal condition induced by disease. It may be further remarked, that when the nervous fluid is modified or vitiated, as it is under certain circumstances of disease, the vitiated portion may be thrown off with the secretions.

Sec. 885. The whole difficulty in understanding the phenomena presented in relation to the heat of living Beings is obviated by considering this heat as a secretion, having the same character, and answering the same purposes in the system that we have attributed to the other secretions—that is, as being the result of nervous influence, and

as furnishing the materials for replenishing the nerves with their peculiar fluid. Under this view, we can comprehend how the heat of animals, for instance, is modified by their ingesta, by their secretions; and, in short, by the modifications of the various sources whence life is derived. And then, again, we can readily comprehend how the various functions of the animal, dependent, as we have seen, on the supply of nervous fluid, may be affected by any change or modification in the process wherein heat is generated, as a considerable supply of the materials for the formation of the nervous fluid is derived from this secretion.

Sec. 886. In diseases attended with fever there is commonly more life taken into the system than is given off; consequently, there is an accumulation of the nervous fluid; and this accumulation is gotten rid of by reducing the supply, and by increasing the excretions, which carries off the excess of the nervous fluid after it has been perfectly elaborated.

Sec. 887. External heat, as that of the atmosphere, is a form of life that is admitted into the living system like other forms of life or matter; but the quantity admitted at any time is limited or proportioned to the capacity of the passages through which it enters, precisely in the same way as the quantity of other ingesta is limited. This, I think, explains the facts connected with an excess of heat in the surrounding medium. In an excess of cold, the system derives life from the atmosphere in another form from that of heat; which other form of life, electricity, probably abounds in such a condition. The constitution is commonly much invigorated in a cold atmosphere. The difference of feeling experienced between a still and a windy atmosphere is, that in the latter there is a greater disproportion between the amount of life given off and received than in the former.

Sec. 888. Moisture, in a heated atmosphere, affects the temperature of an animal by acting favorably on the excretory ducts of the cataneous glands, and thus promoting the secretion from these glands. This, of course, tends to reduce the supply of the nervous fluid in the system that might otherwise be accumulated or expended in the secretion of heat. Does not this increase of secretion more than counterbalance the advantages arising from a dry atmosphere, in calculating the effects of a high temperature on the living system?

Sec. 889. The evolution of heat is commonly proportionate to the activity with which the other vital processes are carried on; hence, in



the germination of seed, or in the flowering of plants, the temperature is preternaturally exalted. The production of heat in the living organism is a vital and not a physical operation; it takes place in accordance with the laws of Physiology or vitality, and not in accordance with the laws of Physics. That it occurs in vegetables or plants, is no proof or evidence whatever that it is independent of nervous agency; for plants have a nervous system, or what is clearly analogous to one—that is, the Pith and Medullary processes. Oxygen is a form of life that seems to enter the living system readily, and to promote the activity of the vital processes; in this way it increases the evolution of heat. There may be, in this portion of the atmosphere, more of the life taken in by living Beings than in its other constituent parts. Insects receive a large portion of life from the atmosphere, and give it off again in the exercise of their muscles in flight, and in some instances in the humming noise they make while flying; which is, in reality, an excretion, requiring the expenditure of the nervous fluid.

Sec. 890. There is no necessary connexion between molecular changes and the evolution of heat; the connexion is only incidental, and the processes are entirely independent of each other. The experiments here mentioned prove nothing in relation to the question before us.

Sec. 891. The experiments here stated are equally futile, for they establish no useful conclusion. By shaving off the hair of the rabbits, and applying the composition, the supply or interchange of life from the atmosphere through the cutaneous surface, and especially through the hair, was cut off, and consequently all the important functions of the animals were more or less impaired or interrupted.

Sec. 892. The effete matter thrown off by the living Being is either in the form of carbonic acid, or may be converted into this form by the operations of the chemist; but this process has no necessary connexion with the evolution of heat. The hypothesis by which this heat is referred to a combustion constantly going on in the living system, appears to my judgment preposterous.

Sec. 893. The reason why the young of most animals suffer from a want of a due supply of heat is, that their means of deriving life in this or in any form from the atmosphere, are defective, and not from a deficiency in the power of generating heat. In animals that suffer most in this state, we find that the organs that bring them into relation with external objects, are defective at birth; such are the hair, the

feathers, the senses, as of sight or hearing, &c. The deficiency in these organs is again felt in advanced age. The further facts mentioned in the remainder of this and in the next paragraph, may be understood by reference to what we have already said.

Sec. 895. Each of the more important functions of warm-blooded animals is dependent more or less on the due performance of other important functions; thus, the generation of heat is dependent on digestion, the latter on the action of the nerves, &c., &c.; but all the vital processes can not properly be said to be dependent on the performance of any one of these functions. Our view of this subject deserves support from the facts stated in the latter part of this paragraph.

Sec. 896. Whenever the store of *nutritious* matter in the system was exhausted, the animals died, not simply from the lowering of the temperature of their bodies, but because the means being no longer attainable for the carrying on the functions of life, the governing principle, the mind gave up its office. When sufficient life was supplied from any source to maintain these functions, the mind, though about to relinquish, resumed its office.

Sec. 897. The reason why the temperature of the living system is not raised when exposed to a heated atmosphere, is very simple, as we have before said; it is because the passages through which the heat passes into the system are incapable of admitting more than a limited quantity; in the same way, as the passages through which other ingesta enter, are limited in their capacity of admitting them.

Sec. 898. The account given of the process of reproduction, like the accounts given by the writer of all the other vital processes, is rendered complicated and very obscure, if not unintelligible, by his rejection of the opinion, that the personal identity of living beings is placed in an immaterial existence, entirely separate and distinct from their bodily organs; and by his obstinately persisting in referring the intelligence, by means of which these bodily organs are made and perform their functions, to the individual cells whose united action, he says, result in the formation of these organs, and which are the immediate agents in performing these functions. This whole hypothesis, which he adopts, seems to my judgment preposterous. It makes the scheme of Creation a system of rank injustice. If the thoughts and actions of a human being be supposed to result from the intelligence of certain cells situated in the brain, and the hypothesis acknowledges the truth of this supposition, would it not be unjust that the whole of his system should be made to

suffer from the error of a part? It removes the idea of accountability altogether, for no individual could be justly held accountable for the acts of a part or parts of his body, over which he, as an individual could exercise no control. The views of the several parts of the system now generally adopted by Physiologists seem to me incongruous and extremely absurd. By assuming, on the contrary, the truth, that there is connected with every living being a separate existence from its body, which is alone possessed of intelligence, and by whose agency even the bodily organs are formed; being instructed to this end, and in all its actions by its Creator, the function of reproduction becomes intelligible, and admits of a satisfactory explanation.

The actions of all living beings are called into play by impressions which inform the mind of some external condition suitable for such actions; the sight or odor of food call into play actions for the gratification of the appetite for food. The conditions convenient for the gratification of the venereal appetite call into play suitable actions, &c. I conceive that the young being is formed in the system of the mother; and in such as require the co-operation of two distinct beings, the semen of the male parent merely serves to make an impression which calls forth the energies of the young being, which are directed towards the formation of its bodily organs. By taking this view, we are brought to a conclusion different from that advanced by the writer. We see that reproduction is a function totally distinct from the function of nutrition. The former being the act of a being separate from its parent, and having no other connexion with it than that of deriving materials for its development.

Sec. 898. The subject on which the writer is engaged in this chapter is rendered confused, by mixing up the actions of parent and offspring, which are in their nature distinct. The act of reproduction, that is, the development of the young, is an act of the young, and should not be confounded with the act of the parent. Portions of the structure of plants and animals are designed to form germs, but the setting free and development of these germs are acts of their own, and not of their parents. The latter furnish conditions and materials for the development of the germs, but this is their only connexion with them. I reject altogether the writer's views in relation to the cell germs, and especially his notions respecting the intelligence referred to them. I believe the cells to be forms of life, which the immaterial principle or part of the Being creates or forms in the course of its development of the bodily organs.

Sec. 899. The pollen grains of plants, and the spermatozoa of animals, are nothing more than highly vitalized portions of semen, which are affected by surrounding objects in consequence of this high degree of vitality, and thus appear to have an independent action in themselves; but there is no evidence whatever that they are possessed of independent vitality, and still less of their being endowed with intelligence. The view I have given of the action of the male semen, seems to me to be in accordance with the operations of Nature observed in other parts of the creation. That the pollen grains, or spermatozoa, contain the germs of the future being, is a gratuitous assumption.

The doctrine of cell growth I reject altogether, and I think I have shown it to be untenable and absurd. Fecundation is that state of an embryo wherein its energies are drawn forth by the external condition in which it is placed. That is to say, the impression made on it by the semen, which fecundates, is favorable to the development of its growth and faculties.

Sec. 901. The inferences drawn here are of no practical value, the appearances being very apt to admit of various or contradictory conclusions.

Sec. 903. The venereal instinct is, like all the other instincts of living Beings, a command implanted in the Mind at the time of its creation by its Creator. This is proved by the fact that such Beings, from their earliest infancy, give evidence of its operation. Pigs and lambs, &c., if a few days old, leap on each other, and undoubtedly imitate the act of copulation, although the function cannot be performed unless under proper external conditions; the semen must be formed, and the circumstances calling forth its emission must exist. These external circumstances furnish the impressions that excite the sexual desire, or, in other words, invite or prompt to the exercise of the function. The seat of this, as of the other instincts, is in the immaterial part of a living Being, or in the Mind, although some particular part of the encephalon may be used possibly more than other parts in the performance of the physical part of the function.

Love is one of the affections, which like the other affections, may be converted into a passion by having the imagination excited. When this excitement of the imagination is rendered permanent by habit, the individual is said to be in love. I see no reason to admit any marked difference between the sexual relations of man, and those of many



other Beings. If there is any, it must be referred to the greater development of the imagination in the former. It seems clear to me, that, if this doctrine of Materialism be admitted to be true, there is no psychological portion of a human, or of any other Being, and that there is no ground to anticipate another world where the feelings may be renewed.

Sec. 904. When the external impressions of which we have spoken exist, the Mind is called on, or urged to obey the command, or to exercise the instinct, by which it is prompted. This it does by means of the nervous system, which it has at its command. By determining the nervous fluid in this system to the genital organs of the male, it causes the secretion of the semen in the testicles, the turgidity and erection of the penis by dilating its tubes, and the emission of the seminal fluid, by causing an action commencing in the excretory ducts of the testes, and passing to the extremity of the urethra. This action consists in the alternate dilatation and contraction of the tubes, precisely similar to that of the œsophagus, of which we have spoken; and we can readily understand that, by means of such an action, the contents of the tube could be conveyed along. The determination of the nervous fluid to the genital organs of the female results in the dilatation of the vagina for the reception of the penis; the conveyance of the male semen probably to the ovaries, by means of an action commencing in the vagina, and passing through the uterus and Fallopian tubes; and then in another action commencing at the fimbriated extremity of this tube, the fecundated ovum is conveyed to the uterus; there to undergo the changes that take place during the period of gestation.

The exhaustion of the nervous fluid in the process of coition is of course attended with a corresponding depression, or suffering in the other functions, which require an expenditure of the same fluid; and this exhaustion, if carried far, may seriously impair many or all of the important functions.

Sec. 909. The purpose of the menstrual flow is the discharge of the superfluous nervous fluid from the system in the unimpregnated state; which fluid, in the natural state, is expended in the several processes of pregnancy. There being a preternatural determination of the nervous fluid to the genital organs at the period of menstruation, that might reasonably be expected to be a favorable period for fecundation, which we have shown requires a preternatural determination of this uid for the various processes before enumerated.

Sec. 910. The expenditure of the nervous fluid in lactation commonly prevents the formation of the catamenia.

Sec. 911. There is no reason whatever to suppose that the function of the female during the coitus is entirely of a passive character. On the contrary, as much action is required on her part as on that of the male—probably much more—as the processes taking place in the female are more complicated, and the actions of greater importance. The turgescence of the genital organs, and the increased secretions, are some of the evidences of such action. The writer's views in this paragraph are confused and unsatisfactory, and his final conclusion absurd in the extreme ; that is, the referring the progress of the semen to the ovaries to the independent action of the particles of this fluid.

Sec. 915. The changes that have been described in the two last paragraphs as taking place in the ovary are referable to the agency of the mother; but the changes that occur in the impregnated ovum are effected by the embryo, the personal identity of which I place in its immaterial portion or mind.

Sec. 916. The development of the cells is but a stage in the formation of the material part or body. The formation of these, as well as of all subsequent parts of the body, is the work of the Mind of the young being, operating through the medium of the nerves, and guided by its instincts. The change in the form of the cells by which they are said to undergo liquefaction results from the fact that the life of these cells is taken away from them, to be employed in the construction of other cells or membranes.

Sec. 918. The gelatinous envelope seems to be the product of the action of the life of the embryo on the secretions poured out by the oviduct or Fallopian tube ; the same may be said of the formation of the shell of the egg. The shell is not properly formed when the ovum is not impregnated.

Sec. 920. The cellular decidua, I conceive, is a formation of the embryo, and is the gateway, as it were, through which the nutritious fluids from the maternal system pass into the system of the embryo. This membrane, or the passages through it, are endowed with a sensibility which admits nothing but what is suited to the growth or nourishment of the young Being. The villous tufts of the chorion take up these fluids after they have passed through this membrane. These fluids having been previously saturated, as it were, with the life or nervous fluid of the mother, are calculated to furnish a supply of life to the infant or embryo for the various purposes of its economy.

One of these purposes is the intimate admixture of these highly vitalized fluids with the venous blood that has already circulated through the fœtal system; by which process it is revived, and again prepared to contribute to the growth of the fœtus. The office of the placenta seems to be the exposure, by means of its convoluted tubes or vessels, of these fluids, still further to the action of the nerves of the fœtus that are distributed to these tubes; by which means these fluids, besides furnishing life to the nerves, become assimilated, or are brought into unison with the system of the fœtus.

Sec. 928. The fœtus, when it arrives at maturity, probably makes an impression on the Mind of the mother, which calls forth her energies for the purpose of causing its expulsion. The first act consists in the cessation of the action of the fibres of the body and fundus of the uterus, the action of which fibres had previously caused the dilatation of this viscus. The dilating cause ceasing, the uterus begins to contract, and the fœtus is pressed down towards the neck of the uterus and the os tinci. The impression made by the closing of the womb on the fœtus is followed by action of the fibres of the parts pressed upon, and of this portion of the uterus. At the same time that the neck and os tinci are dilating, the nervous fluid is still further withdrawn from the fundus, and this part is thus contracted, and contributes to the progress of the fœtus. This contraction of the fundus is still further promoted by the mother diverting the nervous fluid from it by calling into action the muscles of respiration. The action of these latter muscles do not contribute, as is erroneously supposed, to the expulsion of the fœtus by their contraction; but, on the contrary, their action can only tend to the dilatation of the chest, so that the breath is held, as it is said. The assistance afforded by these muscles in the expulsion of the contents of the abdominal viscera arises from their making a diversion of the nervous fluid from the fibres of these viscera; and being voluntary, they are most liable to be called into play for the purpose. The contraction of the body and fundus of the uterus may be still further promoted by making a diversion to the alimentary canal by any irritating cause, as ergot. The diversion may be still better made by the patient's swallowing ice freely, by the application of cold to the surface, and by applying the child to the breast, &c. When there is general plethora, or a redundancy of nervous fluid in the system, general depletion, such as blood-letting, &c., may be necessary to promote or bring on the contraction of the uterus.

Sec. 929. The reason why the period of parturition should be just nine months, or why the return of the menses should be periodical, &c., is simply because the instincts prompt to such acts at such times. The instincts being the commands of the Creator, all such acts are thus resolved into the will of the Creator. This is all that can be said or known in relation to this subject, and is all that is required to be known in order to satisfy any reasonable curiosity of the human Mind. Abortion, or premature delivery, may be induced by causes that seriously interfere with the normal action of the fibres of the uterus, or that cause their preternatural contraction. The attachment of the placenta is broken up by the walls of this viscus contracting more rapidly than the corresponding surface of the placenta. The orifices of the blood vessels of the uterus, as well as the vessels themselves, are contracted by the expenditure of the nervous fluid in the process or act of parturition, and by its transfer from them to the vessels and tubes of the mamma, &c. A knowledge of this truth will suggest important remedies for uterine hæmorrhage. The Lochia is an excretion which expends the nervous fluid and wards off from the uterus excitement and inflammation.

Sec. 935. When the ovum is impregnated, the embryo commences a new series of operations; the result of the first of which is the formation of the cells and membranes, as here delineated. This formation is the work suggested by the intelligence of the Mind of the embryo, guided by its instincts; but this work is not performed by the cells, nor suggested by any intelligence of which they are possessed.

The "*peculiar cell*" may be the point possessed of greater vitality than other cells or points; but the whole of them are but the formations of the embryo, or of the Mind of the young Being. The yolk is in part converted by the action of the nerves into blood, and a part of it is taken into the intestines, to be converted into blood by a longer process.

Sec. 941. The Allantois contains a secretion which furnishes nervous fluid to the embryo, until it is derived freely from the chorion, or from other sources.

Sec. 944. The reason why the Ductus Venosus and Ductus Arteriosus shrivel when the lungs come into exercise, is because the nervous fluid which dilated the former is at birth transferred to the vessels of the lungs; or, in other words, because the nervous action or influence which was, in the fœtus, directed to the former, is at birth directed to the latter vessels.





# NOTES

ON

## ERRATA. PHYSIOLOGY,

- Page 9, line 17, for "observation" read Observation.  
 11, " 7, for "unhapviness" read unhappiness. •  
 17, " 27, for "tribes" read tubes.  
 18, " 23, for "trachea" read tracheæ.  
 35, " 24, the word "are" misplaced.  
 38, " 22, for "to" read for.  
 42, " 25, for "hypothesis" read hypotheses.  
 43, " 30, for "to" read of.  
 49, " 31, for "semblance" read resemblance.  
 52, " 17, for "ejacutio" read ejaculation.  
 52, " 29, for "seminales" read seminalis.  
 57, " 21, for "modern" read moderate.  
 61, " 30, the word "afferent," before quantity, to be omitted.  
 65, " 10, for "corded" read choroid.  
 66, " 9, for "ceralvo" read cerebro.  
 76, " 14, comma after anxiety.  
 81, " 6, for "prima via" read primæ viæ.  
 83, " 28, for "venal" read renal.  
 85, " 28, for "Briffy" read Buffy.  
 85, " 31, for "Poiseville" read Poiseuille.  
 86, " 16, for "ingenious" read ingenuous.  
 86, " 16, for "propositions" read proportions.  
 98, " 9, for "chelonions," read chelonians.  
 110, " 24, for "arcolus" read arcolar.  
 110, " 30, a semicolon after excreted.  
 115, " 24, for "allantoës" read allantois.  
 116, " 7, for "considered" read considerable.  
 118, " 7, for "light" read sight.

RESULT

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NOTES

ON

CARPENTER'S HUMAN PHYSIOLOGY,

CONTAINING

SOME ORIGINAL VIEWS OF THE ECONOMY OF NATURE—THE RESULT  
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BY

LOUIS MACKALL, M. D.

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